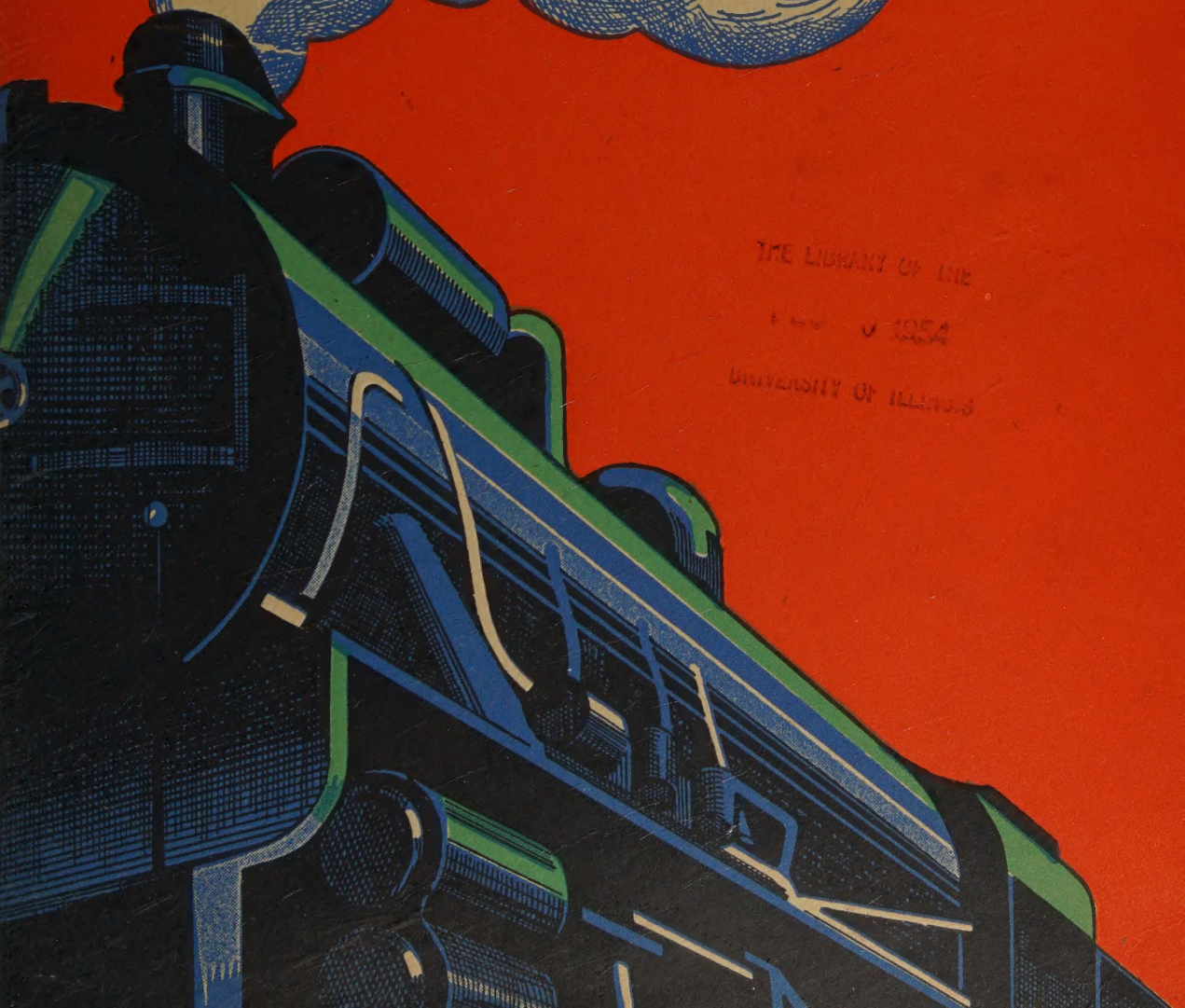


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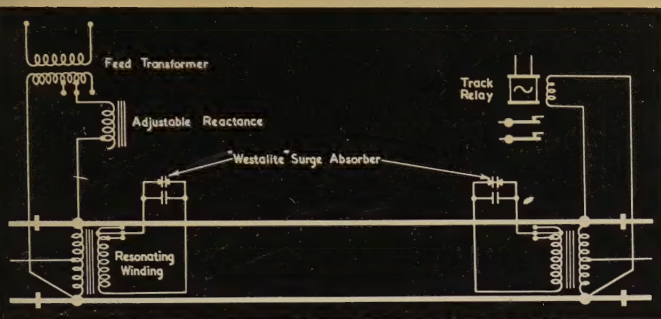


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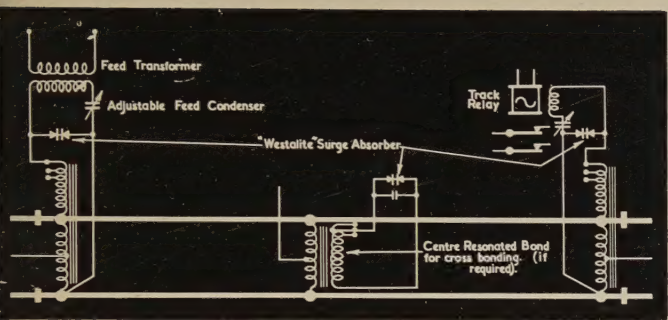




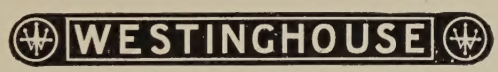


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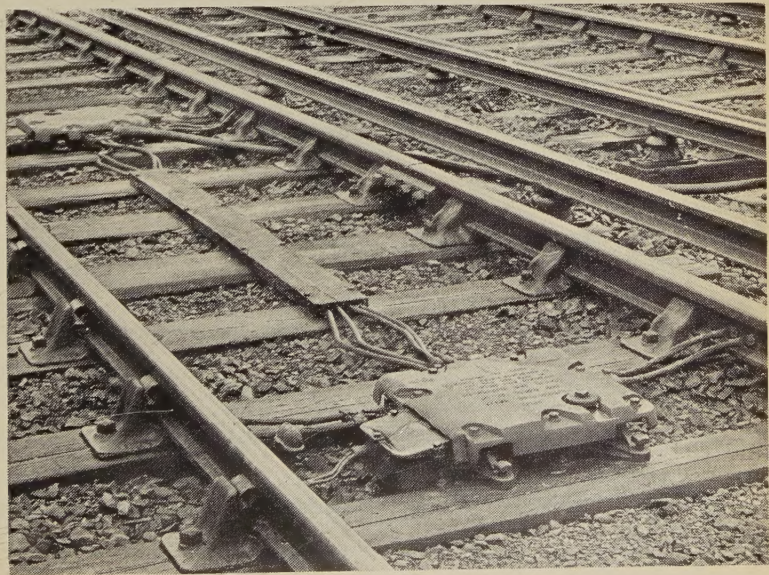


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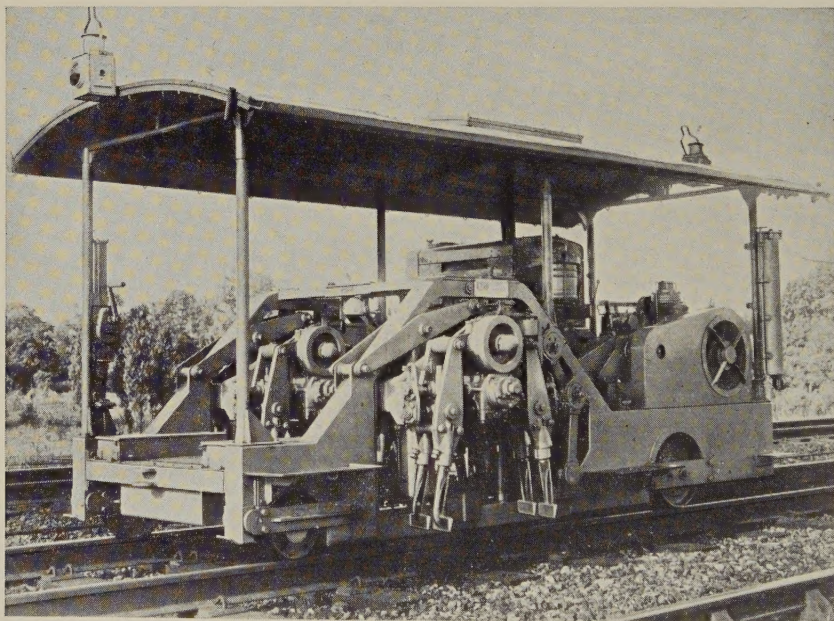

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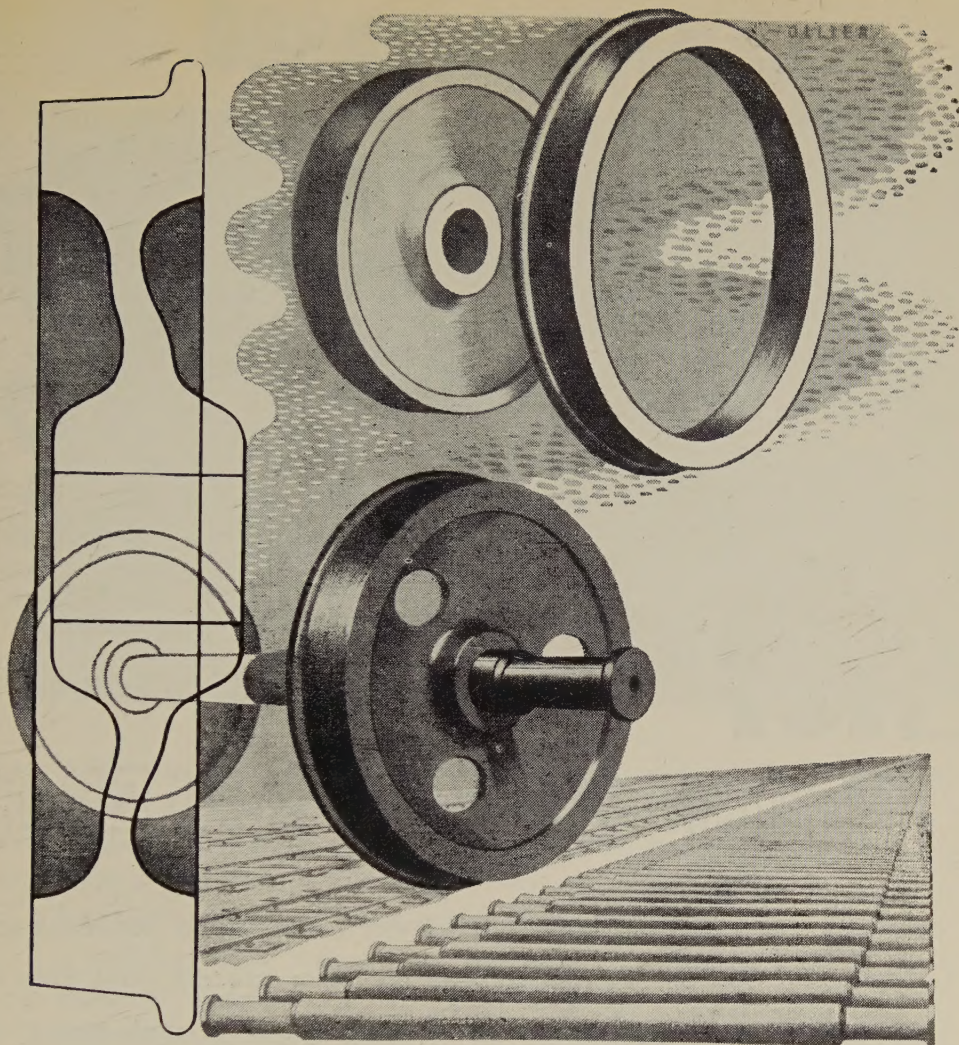
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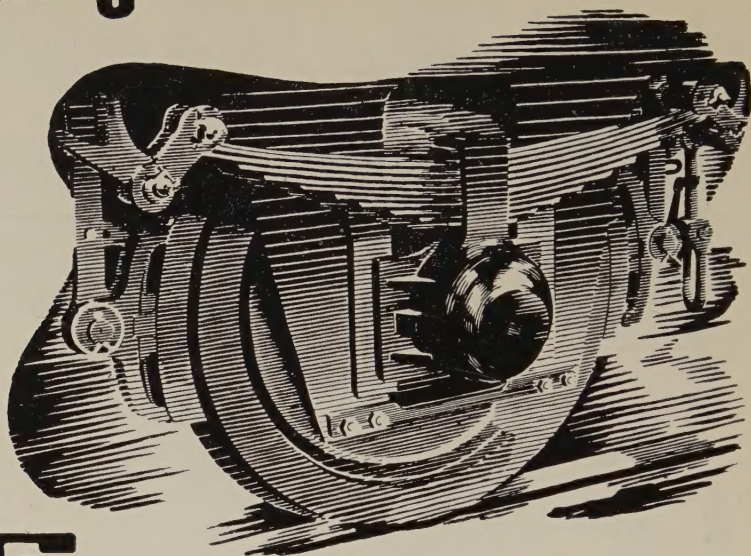
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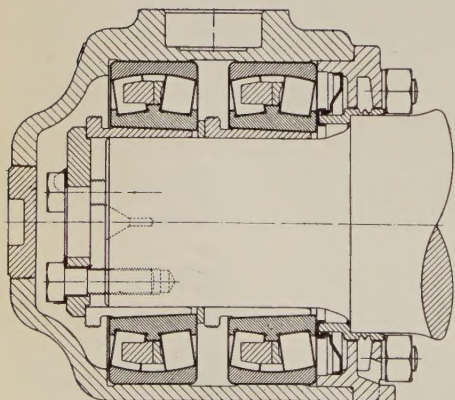
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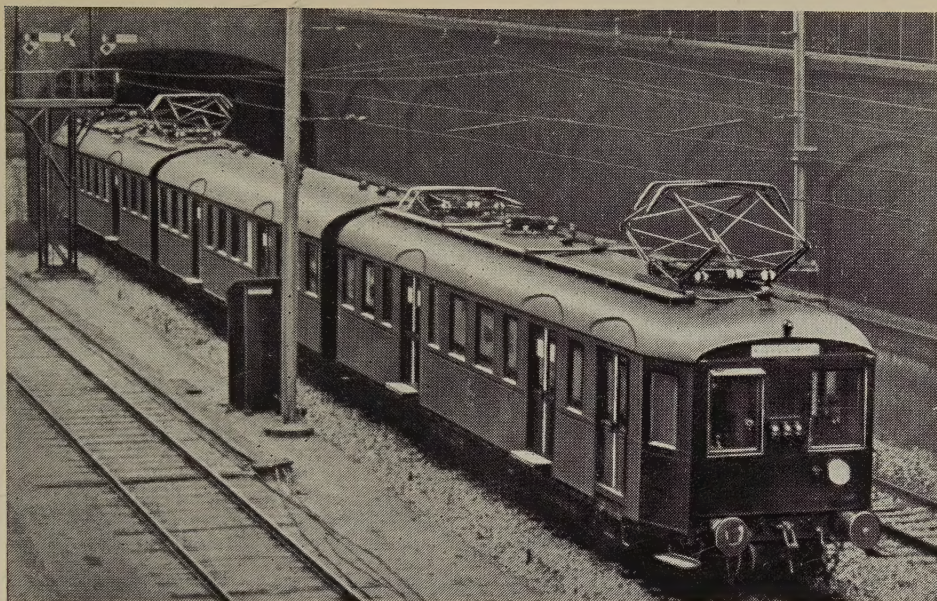
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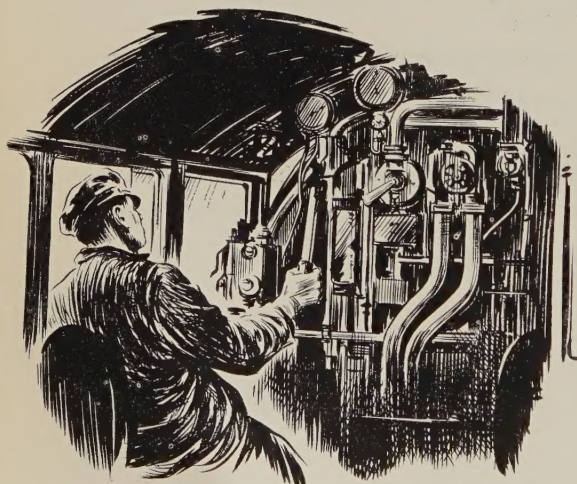




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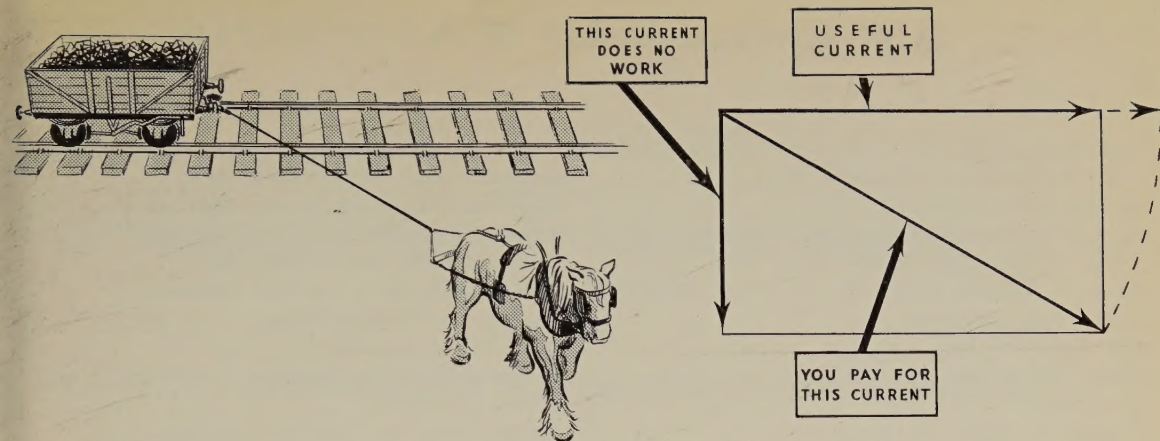
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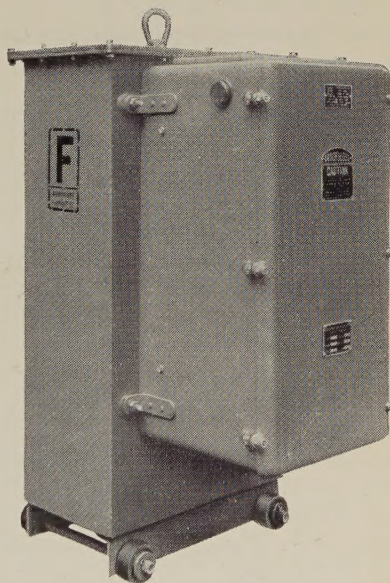


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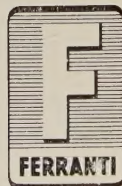
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# BULLETIN

OF THE

# INTERNATIONAL RAILWAY CONGRESS

## ASSOCIATION

(ENGLISH EDITION)

[ 656 .1 ]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th. SESSION (LONDON, 1954).

### QUESTION 9.

## Railway participation in road transport undertakings.

### REPORT

*(America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, Netherlands, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible),*

by Dr. J. P. B. TISSOT VAN PATOT,

Chief of the Cabinet and General Policy Division of the Netherlands Railways.

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## PART I. INTRODUCTION.

### CHAPTER 1.

#### Preface.

1. The Questionnaire sent to 38 Railway Administrations has been replied by 23 of them. The *Malayan Railway* and the *Burma Railway Board* stated that they were not able to answer the various questions. The *Iraqi State Railways* said that they do not participate in road transport undertakings. The *Grängesberg-Oxelösunds Railways* referred to the reply of the *Swedish State Railways*. The *Sudan Railways* stated that they are not financially interested in any road transport undertaking. The *Association of American Railroads* gave a general reply to the questionnaire and are of the opinion that highway as well as rail operations in the United States are on a much different basis than in European countries, which makes it impracticable, if not impossible to answer the various questions specifically.

The replies received from the following Administrations have been summarized in this report :

*Denmark* : Danish State Railways;  
*Egypt* : Egyptian State Railways;  
*Eire* : Coras Iompair Eireann;  
*Finland* : Finnish State Railways;  
*Great Britain and the Commonwealth* :

British Railways (the Railway Executive);

London Transport Executive;  
 Ceylon Government Railway;  
 Indian Railway Board;  
 East African Railways and Harbours;  
 Rhodesia Railways;  
 South African Railways;  
 New Zealand Government Railways;

*Iran* : Iranian State Railways;

*Netherlands* : Netherlands Railways;

*Norway* : Norwegian State Railways;

*Sweden* :

Swedish State Railways;  
 Nora Bergslags Railway;

*United States of America* : Association of American Railroads.

2. The reporter wishes to express his most sincere thanks to all Administrations who have taken pains and trouble in preparing their answers to the questionnaire. He would especially like to thank those Administrations participating in road transport undertakings, who by their detailed information and considerations facilitated his task in making this report.

### CHAPTER 2.

#### General introduction.

##### *The adoption of a new technique.*

3. The phenomenon that railways participate in road transport undertakings is not unique. Everywhere in the economic process we meet with this occurrence in its general form, i.e. the semi-direct operation of a new technique in replacement of or in addition to an existing production system. Adopting a new technique is typical for a living national economy in which the needs vary, technical knowledge develops and the organisation of production is adapted to suit the varying needs and the developing technical knowledge.

No industry which endeavours to continue its existence can afford to watch the development of needs, production techniques and organisation methods, and remain inactive. On the contrary: adopting to suit new needs, new technical machines and up to date methods of organisation are a daily activity for a living industry. Adopting and adapting is a question of « to be or not to be », to progress or to stagnate.

It is the same for a company. They can not afford to dwell on old products, old techniques and old methods of organisation. It is essential for an undertaking to continually keep in step with the varying requirements of its customers, with the development of technique and consequently to adapt its technical process to it.

When does an undertaking adopt a



new technique? Three cases may be distinguished:

1) when the undertaking with the aid of new technical expedients expects to manufacture at less costs products which are already on the market; i.e. when adoption leads to *rationalisation* of the production process;

2) when the undertaking expects to produce with the aid of new technical expedients products of a higher quality, i.e. when adoption leads to *improvement of quality*;

3) when the undertaking is able to put products on the market with the aid of new technical expedients, which are expected to provide for new requirements or to provide better for the existing ones, i.e. when adoption leads to *an increase of the assortment*.

In all these cases as far as its earning power is improved or maintained, the continuity of the undertaking is likewise improved. In the first case by reducing its costs, in the second and third case by maintaining or improving its position in the market towards its rivals.

#### *The various modes of organisation.*

4. An enterprise which decides to adopt a new technique may make a choice from the following three modes of organisation:

1) *the indirect method*: the product is manufactured by an existing undertaking and contracts are made for this purpose;

2) *the semi-direct method*: for the application of the new technique a separate economical unit, a new undertaking is established or participation takes place in existing undertakings which apply the new technique;

3) *the direct method*: the new technique is applied by the undertaking itself.

5. Each of these methods has its advantages and drawbacks, which according to the objects have to be weighed against each other. In the first place the undertaking will be guided by economical considera-

tions, thinking in terms of costs and revenues. Imponderabilia, connected with the existing production process and external factors, such as legislation, which do not leave the undertaking free in its choice, will also have to be taken into account.

To give a long explanation of the advantages of each of the different methods of organisation is not considered necessary for this general introduction. Therefore mention is only made of some of the important considerations in favour of each of the three methods.

In the case of *indirect operating*: the following considerations may be taken into account:

1) production by the method of direct or semi-direct operation can lead to an incomplete use of the specialised staff and of the technical apparatus;

2) the opportunity to stop the production at short notice is preserved;

3) the risk of production is reduced or eliminated;

4) it is not possible or not desirable to invest money in the new technique.

With *direct operating* the following considerations may be taken into account:

1) there exists a very close technical cohesion between the successive technical processes, e.g. when the successive phases of manufacture must correspond to each other accurately for the sake of quality;

2) certain parts of the apparatus or of the organisation can be used together for the two technical processes; so that a higher degree of loading is obtained.

With *semi-direct operating* the following points may be considered:

1) the two production processes are of such a divergent character that different knowledge is required by the management;

2) the two production processes owing to the difference in their technical structure, require a different organisation;

3) the undertaking requires commercial



management different from that of the other undertaking;

4) there is a difference in wages and labour conditions;

5) the new production process in technical or economical respect must be carried out on another place than that of the old technique;

6) it is desired to take a rival from the « market » and yet to retain and use his « goodwill »;

7) it is only desired to obtain a restricted influence on the market, so that great liberty can be left to the control of the technical process;

8) it is desired to reduce the economical risk of the new technical process;

9) to obtain with the smallest possible investments the largest possible power or influence (participations with less than 100 % and more than 50 %, respectively less than 51 %).

There is another important consideration of a more general character. This is connected with the effect of each of the three modes of organisation on the control and the division of tasks in the production process. With direct operating the undertaking itself has to execute all tasks, but by doing so it has complete control of the whole production process. With indirect operating certain tasks, depending on the provisions of the contract, are completely or partially carried out by contract, but in this case the undertaking loses the control of the production process. With semi-direct operating on the other hand delegation to a very great extent of tasks is possible, whereas complete control, on account of the relation of power between the parent and subsidiary company, is maintained. In those cases therefore where it is desired to maintain or to obtain complete control of the production process, e.g. because of the reputation of the undertaking or because they want to market the product and still wish to delegate some tasks, there will be a tendency to participation in the undertakings. In these cases it is sufficient

to indicate the general policy and the working rules for its execution.

Finally there is the institutional factor. Participation in existing undertakings is the only possibility left to a company to offer their products and to obtain influence on a market, closed to newcomers. A similar closure often results from the introduction of a Government licensing system.

## CHAPTER 3.

### Special introduction.

#### *The adopting of road vehicles by railways.*

6. A railway undertaking whether a private, a semi-governmental, or a governmental undertaking, is, just as every other company, living in a world which is in a state of constant evolution. The needs of its clients, the consignors and the passengers, are continually changing. Also the technique of traffic shows developments<sup>(1)</sup>, which sometimes take place gradually and sometimes change very rapidly. A living railway, just as every enterprise, must adapt to the needs of the public, has to adopt new techniques and should change its organisation to the altered needs and to the new and modified techniques. It is imperative for the railway to do this to ensure the continuity of its existence, for the benefit of its clients and moreover for reasons of national economy, in which it performs a most important task.

One of the technical developments of this century is motorised road transport: the bus for passenger transport, the lorry for goods transport. The railways all over the world just as other enterprises had to take stand against the new technique. In particular they had to answer the questions:

1) will the new road vehicles reduce the costs of my services?

<sup>(1)</sup> A. SJÖBERG'S report at the 1952 meeting in Stockholm published in the *International Railway Congress Association Monthly Bulletin*, 1952, vol. XXIX, p. 201 (English edition), and p. 379 (French edition), treats thoroughly these modifications in needs and techniques.

2) will they improve the quality of my services?

3) will they help me in providing for the new requirements of consigners and passengers and will they be useful for maintaining and or increasing my sales?

Many railway undertakings answered one or more of these questions in the affirmative and consequently adopted road vehicles. The new road vehicles appeared to make valuable contributions to the rationalisation of the undertaking. Detailed examples need not be treated here, they are generally known. The bus could be used to replace some or all trains on sections with low passenger traffic. The lorry could serve to organise piece goods transport in which the long distance transport takes place by rail and the local and regional collection and delivery services could be made by the lorry, with the effect that many lightly loaded short distance goods trains could be eliminated.

The use of modern road vehicles could also lead to the improvement of quality of the transport services. The bus could offer a much higher frequent service than the passenger train on account of its smaller capacity per unit for the same traffic. The truck made it possible to accelerate piece goods transport considerably.

The increase of the assortment of transport services, which may result from the use of road vehicles was also important. It could take place in two parts, increase of the number of transport connections and increase of the various categories of transport services. Though in former times the railways were tied to the iron road, the bus and lorry have given them access to spots not situated on the rail and so enabled them to build up a very dense network of transport services of a high quality. Secondly road vehicles made it possible to enlarge the different categories of transport services, by which the varied demand of consigners and passengers could be better served (e.g. tourist excursions by bus, through road services by lorries; door to door transport for large quantities with the aid of containers). Adopting a new

technique gives the railways the opportunity to become general transporters and to break the historical shackles by which they were tied to rails only. This technical integration within an enterprise or a concern is for the benefit of the railways themselves, of the consigners and the passengers and it also facilitates the building up of a rationally working national transport system <sup>(1)</sup>.

#### *Opposition against adoption.*

7. Many railways, after studying the qualities of bus and lorry were convinced that the use of road vehicles would help them to rationalise their undertaking, to improve the quality of their transport services and to enlarge the assortment of transport services, but met with special difficulties when adopting the new technique. Adoption appeared to cause opposition from transport undertakings, which also used the new technique, e.g. the professional bus and lorry services.

This opposition must be called remarkable and inconsequent, for in many cases the bus and truck carriers did the same as the railways. In many countries the truck carriers arose from the former regular and irregular services, when horse and cart were used. The owners of horse and cart transport services have also applied a new technique in replacement of or in addition to their old technique; they transferred to the new technique in order to rationalise their undertaking, to improve the quality of their transport services and to enlarge their variety; they also created services which had not been run before and which belonged to the indisputable domain of the railways. Moreover they offered more kinds of transport services than they had before, e.g. they used special cars for special transports.

The owners of bus transport services in

<sup>(1)</sup> See also the report by A. SJÖBERG, I.R.C.A. *Bulletin*, 1952, vol. XXIX, English edition, p. 290/118, and French edition, p. 470/124.



former times were often jobmasters and stagecoach hirers. They improved the quality of their transport services and enlarged the variety of their transport services by opening connections, which in former times were only operated by the railways. They, however, denied the rail- and tramways the adoption of the new technique which was applied by themselves.

The carriers, who had never before been active in the domain of transport, but had taken part in the production process elsewhere, and who saw in the bus and the lorry a better means of livelihood, did the same. They became active in an entirely new field, but were of the opinion that they could deny the railways the right to apply a new technique in their own field.

The opposition against the adoption of road vehicles by the railways is also remarkable on account of its shortsightedness. Too much consideration is made of the technical aspect of the use of bus and lorry services and it is not considered as a transport service demanded and offered as a product on the market. In other words, one only thinks technically, but not economically. From the economical point of view it is irrelevant for the customer which technique is applied, the quality of the transport service being the same, and whether the carrier transfers from one technique to another. In the transport market the consigner does not meet people who offer transport techniques, but people who offer transport services of various qualities. The carriers do not compete with technical apparatuses, but with transport services.

Moreover the tendency to limit an enterprise to a technique does violence to the natural course of the production process, as the latter is inverted by it. The entrepreneur starts from a certain product that he wants to produce and makes his choice from the various possibilities the technicians submit to him. He will adapt the technique to the product which promises the most lucrative sale, i.e. the product that meets the needs of the public as much as possible and that gives him the greatest

balance between costs and proceeds. The advocates of a tie to a technique, however, reverse the procedure: they take the technique, the entrepreneur applies, as a datum and are of the opinion that he has to adapt his product to suit the technique, even when the product does not meet the desires of the public in every respect.

If therefore from the economical point of view the opposition against the use of road vehicles in order to rationalise the production process or to improve the quality of the transport service is untenable, also the opposition against the increase of the variety can not be accepted from an economical point of view.

It has been pointed out before, that it is correct for the existence of an undertaking to secure its continuity. The whole management is directed to this. For this it is necessary to maintain the undertaking in the industry, where it belongs to. Therefore dynamically acting is imperative in order to get an expansion of the assortment of products and of markets.

From the economical point of view this expansion has great advantages. The « know how » within an undertaking is maintained, expanded and further exploited. The development of the chemical industry gives a clear illustration of the value, this maintenance and further development has from a social point of view. The remark of the management of Dupont de Nemours in 1937 is well known in that an important part of their production consisted of articles, that were unknown some eight years previously and which they had developed in those years <sup>(1)</sup>. Is it thinkable that every development of technical-chemical methods could be denied to an existing undertaking and would be a privilege to a new undertaking?

It is advantageous from the social point of view when the many technical possi-

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<sup>(1)</sup> D. LYNCH: *The Concentration of Economic Power*. Columbia University Press, New York, 1946, p. 102.

bilities and the progress in the domain of technical production are managed within the whole of one undertaking. In this way an economically justified inclusion of new technical possibilities in the existing production process is obtained and social losses are prevented by a smooth development.

The opposition by the professional bus and lorry carriers did not only manifest itself normally in a competition struggle, by which due to the costs and to the choice of the clients the decision was obtained, but especially in an appeal by the professional carriers to the Government. Not especially the economical grounds are brought forward to limit the railways to their technique. Such an appeal — in view of what has just been pointed out — would not be sound. Therefore an appeal is also made on grounds of a general political character. In some countries this takes the form of support of the middle classes towards large enterprises; in other countries where the railways are directly or indirectly controlled by the State, it is desired that the State restricts itself to that which is necessary (i.e. operating the railways), and keeps aloof from that which private initiative is able to perform (i.e. bus and lorry services).

This incorporation in general politics naturally makes the position of the railways difficult, because the adoption of road vehicles is thus drawn outside the economical discussion. However, against the argument of protection of small enterprises we may put forward the sound defence that the Government has means at its disposal, to protect the small undertaking from becoming the victim of unfair competition by a large undertaking, other than prohibiting the railways to operate road vehicles. Against the argument to restrict State-activity in transport as much as possible it may be said, that if it is desirable to operate the railways as Government concern then consequently they have to be given sufficient chance for existence. This argument is even stronger, if it is demanded that the railways must try to

make a balanced budget and that they are not allowed to appeal to the treasury. This aim cannot be reached by an undertaking which has been frozen technically (i.e. with regard to its production apparatus) and economically (i.e. with regard to the assortment of services and markets). Then the possibility to rationalize and to adapt itself to the needs of its clients is taken away from the undertaking. In the transport industry a standstill means also a decline. As long as railways are essential they cannot be denied the possibilities of development on and outside the railway line itself.

#### *The three modes of organisation.*

8. When adopting road vehicles the railways have applied all modes of organisation mentioned in item 4. As it appeared before, there are various factors for each mode of organisation which turn out to its advantage. It has also been pointed out, that these various factors will have to be considered against each other, if it is desired to make the right choice in certain circumstances. The following remarks therefore cannot be but rough indications of the direction in which a solution had been sought.

It is of importance whether one wishes to adopt road vehicles in passenger or in goods transport. In freight traffic it is very desirable to keep the responsibility of « door to door » transport unbroken. In passenger traffic it is possible to let each transporter bear the responsibility for his part of the process. Passenger traffic therefore requires less direct and semi-direct operation than freight traffic.

In piece goods traffic attempt was made to rationalize the railway undertaking with the aid of the truck, to accelerate the traffic and to give new traffic connections. An important point in the organisation of piece goods traffic is the accurate integration of the various actions. A close connection of one part of the process (rail-transport) and the other parts of the process (supply and conveyance by truck)



indicates the way to direct operation. On the other hand the technique of road transport deviates greatly from that of rail transport, also the commercial climate for non-railborne transport is often quite different, so that there are indications here for semi-direct operation. Some railways considered the close organisation the main point, others the technical and commercial difference, so that some of them apply the method of direct operation, whereas others apply semi-direct operation <sup>(1)</sup>.

Moreover semi-direct operation of road vehicles in piece goods transport copes with the two requirements, which the collection and delivery services have to meet with. Mr. G. MOULART pointed this out in his report for the Lisbon Congress; treating Transport of miscellaneous goods <sup>(2)</sup>, viz., using a firm « whose general costs and social obligations are considerably less than those of the Railway, which usually has not to respect the strict working hours with the same rigour as the latter, and on the other hand, the interest the Railway has in keeping a very close hand on the haulage services in order to keep check on the quality of the service and prevent traffic being lost to its competitors ». In other words one may not lose control of the quality of the service and the contact with the customer.

The method of indirect operation (contract) has also been applied by many railways in piece goods traffic in cases where the transport capacity was insufficient to get a reasonable cargo degree for the truck with railborne piece goods. Here a com-

bined loading with non-railborne traffic must bring relief. Measures must be taken to exercise an intensive supervision on the quality of the service and to look especially after the contact with the customer.

If the railway wants to put on the market an entirely new product with the aid of road vehicles, whereby the common use of parts of the rail transport apparatus is small and the association with the rail technique does not make high demands of accuracy, the necessity for direct operation is also less stringent and the advantages of semi-direct operation are clear, supplemented with indirect operation, where enlargement of the variety is only incidentally.

Commercial motives are very important when the influence or abolition of competition on routes parallel to the railways are at stake. Especially in countries where the Government has placed the bus and truck services under a licence and consequently has often given them a monopoly and closed the market to newcomers, participation is often the only way which can be taken to offer road transport services or to relieve or take away the competition of certain road transporters.

When studying the various methods of organisation, more than pure economical considerations and the course of the historical process will have to be taken into account. It is possible, due to political considerations that more use is made of the contract than would result from economical considerations. In countries, where the railways cannot or can only with difficulty proceed to participation, they will often be compelled to use direct operation. Also in countries, where transport facilities have still to be developed, there is probably less opportunity to apply semi-direct operation.

The course of the historical process is also of importance. If on account of rational or political grounds a self controlled organisation of some extent has been built up gradually, then from the

<sup>(1)</sup> The Netherlands Railways e.g. for the purpose of obtaining the close organisation transferred the handling of piece goods in the sheds and the handling of the bills of lading to the road transport undertaking; their task is restricted to transporting the goods waggons between the goods-sheds.

<sup>(2)</sup> *Monthly Bulletin of the International Railway Congress Association*, 1949, vol. XXVI, p. 248/10 (English edition) and p. 305/21 (French edition).

point of view of favourable loading of the existing production apparatus, staff and material, the further development will take place through the channel of direct operation, however, where a large apparatus can be built or participation made in many undertakings at the same time, the semi-direct operation is applied. On the other hand from a point of view of rational operating the subsidiary may be charged with tasks, for which in other circumstances direct operation would be the obvious way.

9. All this does not alter the fact that the method of semi-direct operation of road vehicles by means of subsidiaries has special advantages which deserve attention. Under item 5 various benefits of this method have been mentioned in general. Some of them are also good for the special case of railways wanting to adopt road vehicles.

Rail and road transport technique show such a divergent character that other technical knowledge is required by the management of a railway undertaking than that required by the management of a bus or truck company.

The commercial management of the road transport undertaking can and will often be different from that of a railway undertaking. In many countries the commercial management of the railways is submitted to much farther reaching obligations than road transport. Moreover the cost and tariff structure of road transport differs from that of the railways.

Often the wages and the labour conditions of the railway undertaking are higher than those of the road transport undertaking.

It is also important that in a road transport undertaking decentralisation for the purpose of an efficient management can take place much easier than in a railway undertaking. Rail transport is effected over much greater distances than road transport: the former is more national, the latter more regional. The railway undertaking in a large country can there-

fore establish similar subsidiaries to a regional extent. These regional undertakings can be better orientated for the particular needs of the region than the more centrally directed railway undertaking.

The psychological advantage obtained by allowing the undertaking to continue its independent existence after participation is very important to railway undertakings who want to operate road vehicles as in this way the subsidiary's goodwill with the public is maintained.

The railways can also profit from participation with respect to investments. It is not necessary that they buy fleets of vehicles and built and equip garages and workshops. It is sufficient to have a share in the capital of the bus or truck undertaking, giving them sufficient influence and power, and paying them a compensation for the goodwill.

The form of participation therefore has many attractive characteristics. They may be summarized as follows: the road transport undertaking is given a status corresponding to the other road transport undertakings, with which it often has to compete, and it operates under the same circumstances as the rivals; i.e. a railway owned road transport undertaking has the same character, works in the same climate, is submitted to the same laws, can speak the same language and acts in the same way as any other road transport undertaking, which together with the railway undertaking in the transport market competes for clientele.

Moreover there is also for the railways the above mentioned general advantage of the organisation of subsidiaries, giving the possibility of a large delegation of tasks to an economical independent unit. Generally the railway managers are fully occupied with the many and important problems of railway operation. Under this heavy burden it must be welcome for them to delegate to a large extent the production and sale of road vehicle transport services to the managers of subsidiaries.



*Conclusion and summary.*

10. From the above it is found that the adoption of road vehicles by the railways offers a good means to rationalize the undertaking, to improve the quality of the transport service and to enlarge the variety of their transport services.

Rationalisation and expansion of the railway undertaking is a subject, which is receiving much close attention in the various Administrations today. The meeting in Stockholm gave evidence of this when the economical aspects of discontinuing service on old railway lines and the construction of new railway lines were discussed. In the accepted summaries the necessity of use of other than rail technique is plainly expressed.

Summaries 2 and 3 stated :

« 2. In order to enable the railways to fulfil, under the most economic conditions, their role as general transport undertakings, they must be empowered, within the general framework of transport legislation, under certain circumstances, with a priority right, for the substitute services, to provide and to operate the most economic form of transport.

This solution will assure transport users the best guarantee of dependability, comfort and adequacy of service. »

« 3. In such a system of public transportation, road transport is, in principle, used as a means of regional collection and dispersal from and to certain concentration points situated on the most important railway line. Under these circumstances, road transport may be substituted, within the bounds needed, and under the responsibility of the railways, for rail service.

Experience shows that such substitution is most easily arranged and administered under a single authority <sup>(1)</sup>. Complement-

ary rail/road service has never been attainable where there is far reaching competition between separate rail and road undertakings. »

The liberty to use road vehicles has been made a fundamental fact in these summaries. The Government is asked for a priority to operate substitute services. This priority is almost natural, as it is a question of continuation of historical rights : the railways having previously offered transport services on these routes.

It has been pointed out above that the railways can also use road vehicles to offer new transport services. Thus they remain in the historical line of the obligation they had in many countries to provide services for the whole country. The construction of non-paying lines has been the effect of this obligation. Moreover the enlargement of the variety of the transport services is a very normal phenomenon in economic life : it is only a normal result of development from which the consigner and passenger also benefit.

When using road vehicles to rationalize, to improve quality and to enlarge the variety, semi-direct operating by means of participation of the railways in road transport undertakings is one of the most important forms of organisation.

Participation may take place in undertakings which are being established for the purpose of semi-direct operation, but it may also be done in existing road transport undertakings. Participation in new undertakings may be applied in those cases, where the railways want to use the right they have requested to substitute certain activities by a new method. Participation in existing enterprises is often the only possibility for a railway undertaking in a country where the Government does not allow such substitution because they have issued licences for the use of road vehicles and have thus closed the market. In this way « single authority » desired at the end of summary 3 is obtained, which is necessary for an easily organised and

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<sup>(1)</sup> From an exchange of views during the plenary meeting it is understood that it is only the Railway Administration, who must organise and operate the substitute road services. By « authority » it is therefore meant the Railway Administration.

administered substitution of rail by road services.

But also in cases, where simple substitution has been allowed, participation in existing enterprises has the great advantage that it removes a competitor from the market and thus reduces or abolishes competition. Thus a form of internal co-ordination is obtained, fitting perfectly the external co-ordination which is the Government's aim.

#### *The investigation.*

11. The importance of adopting road vehicles and the for this purpose suiting method of semi-direct operating justifies an investigation into the participation of railways in road transport undertakings. The questionnaire served to trace how far the railways have already used this form of participation to operate road vehicles.

In the first place the possibility of participation is discussed in the questionnaire. Attention has already been drawn to the opposition which is met from the existing road transport undertakings against participation by the railways in road transport, in spite of the form of organisation applied. Moreover there are in many countries bus and truck service legislations which may restrict the railways in their liberty to participate or just compel them to participate. Finally it is possible that the right of participation is denied to the railways, because the State operates separate nationalised bus and truck services.

Further an inquiry has been made about the actual participation, its motives, its extent, the kinds of transport services the subsidiaries carry out. Inquiries have been made about the methods and the organisation of participation.

Questions have been put at the end about the results of participation, whereby a distinction has been made between financial and other results. The questions whether these results lead to extension of the participation complete the series of questions.

Though in the questionnaire stress has been laid on the participation in road transport undertakings, it is necessary for complete understanding to pay also attention to direct and indirect operating of road vehicles.

## PART II.

### REPLIES TO QUESTIONNAIRE.

#### Heading I.

#### *Possibility of participation.*

#### CHAPTER 1.

#### *Questions 1 to 5 inclusive.*

1. *Are your railways authorised to operate road transport services? If so, are they allowed to participate in road transport undertakings either directly or by contract?*
  - a) *have they full liberty of action in this respect?*
  - b) *is this liberty of action restricted? If so, by what? (e.g. the necessity for Government approval);*
  - c) *is such participation not allowed? If so, by virtue of what law?*
2. *If you have not taken advantage of the possibility of participation, what is the reason?*
  - a) *is the competition of such a character that you do not find it necessary to participate?*
  - b) *do you prefer road transport operation by a separate statutory organisation to participation?*
    - ba) *if so, in which way and why?*
    - bb) *if not, why not?*
  - c) *are there other reasons why you do not take advantage of the possibility of participation? If so, what are they?*
3. *If you cannot participate do you think it desirable to obtain authority to do so, and why?*



- a) if for motives other than railway considerations, what are they?
  - b) to meet the competitive conditions:
    - ba) by enabling the railway to control, through such participation, the existing transport market, yet at the same time retaining the road transport undertakings, competition being eliminated;
    - bb) by allowing the railway to obtain a dominating position in the inland transport market;
    - bc) by allowing the railway better to protect its position in the transport market relative to the competition from other road transport undertakings;
    - bd) by allowing the railway to take advantage of new developments in the transport field;
  - c) to enable the railway to make use of the two forms of transport — rail and road?
  - d) for other reasons?
4. If you are not able to participate in road transport undertakings and if you do not consider participation desirable, what are your reasons for this view? e.g.:
- a) the absence of road competition?
  - b) the use of some other form of road transport operation (such as by a separate statutory organisation) and to what extent?
  - c) other reasons?
  - d) are there in your country nationalised undertakings other than railways which are operating road transport services with the status of a separate statutory organisation? If so, what kind of transport services are provided and to what extent? What are the relations between these undertakings and the railway.
5. Are road transport services operated by a separate statutory organisation?
- a) to what extent?
  - b) what are the advantages and disadvantages of this system?
  - c) are there in your country nationalised undertakings other than railways which are operating road transport services with the status of a separate statutory organisation? If so, what kind of transport services are provided and to what extent? What are the relations between these undertakings and the railway?

## CHAPTER 2.

### Replies.

12. From the answers given it is clear that the railways can be divided in two groups for these questions i.e.:

A. — Railways which form part of a nationalised general transport undertaking which besides rail transport also operates road transport services. These railways not forming an independent organisation in general have no right to operate road services and to participate in road transport undertakings; the organisation in which they are incorporated is entitled to do so. The railways in Great Britain and Eire belong to this group.

B — Railways which form an independent organisation. In general they have been authorized to operate road services in some way or other, and many of them are entitled to participate in road transport undertakings.

### A. — The non-independent railway undertakings.

13. In Great Britain, according to the Transport Act, 1947, important parts of transport — e.g. railways and parts of road transport — have been nationalised and placed under the management of the British Transport Commission (B.T.C.), whose task it is to provide, secure, or promote the provision of an efficient, adequate, economical and properly integrated system of

public inland transport and port facilities within Great Britain for passengers and goods. To assist the B.T.C. in the discharge of its functions public authorities have been created, known as Executives. The Railway Executive (R.E.) has to deal with the British Railways, the Road Haulage Executive (R.H.E.) with transports of goods by road, the London Transport Executive (L.T.E.) with passenger transport within the London area. The bus companies of the B.T.C. are controlled by the Commission itself.

In this position we may consider the *British Railways* as a part of the large transport company of the B.T.C. and it is clear that when the Transport Act 1947 was put into operation the participation of the British Railways in road transport and in road transport undertakings assumed another form than when they were independent private undertakings <sup>(1)</sup>.

When in 1928 the four main line railway companies were authorized to use road vehicles, they decided on a policy of financial investment in *passenger* road transport companies rather than direct operation and accordingly, the existing railway owned companies and rail operated services were transferred to omnibus companies. Shareholdings in varying amounts were acquired by agreement in these and in other omnibus companies, which subsequently became merged into three main groups: (1) Tilling, (2) Scottish Omnibuses and (3) British Electric Traction. In addition, working arrangements were made with four municipal corporations.

With the passing of the Transport Act, 1947, the whole of the investments and

interests of the former railway companies in road passenger operations were vested in the B.T.C. and since then the Commission had acquired a controlling interest in the first two of the main groups quoted above, and also in a number of individual companies, which have since then been absorbed by the Tilling Bus Group.

Question 1, whether the British Railways as such are allowed to participate in passenger road transport undertakings, must be answered in the negative: B.T.C. is entitled to do so. Question 5 — are road transport services operated by a separate statutory organisation — is answered in the affirmative for passenger traffic in Great Britain. The passenger road transport services with which the Railways are associated are operated by separate limited liability companies, the share capital is held either wholly or in part by the B.T.C. except that in a few cases there are road services operated by the railways jointly with certain municipal undertakings, such as the Sheffield Corporation.

The areas in which the first mentioned companies operate cover almost the whole of Great Britain, but in these areas there still are a large number of smaller non statutory concerns operating road services to varying extents in competition with the railway and/or the railway associated companies.

The principal advantages of the system of semi-direct operation by separate companies are — as stated by British Railways:

1) that it has not been necessary to embark on considerable capital expenditure to build up fleets of passenger road vehicles throughout Great Britain or to set up a large railway department to operate passenger road services, and

2) that use is made of the knowledge of these who have had long experience in the operation of passenger road transport.

Any disadvantage of this system that may have arisen as a result of the operation of the passenger road services not under the control of the railways has been overcome

<sup>(1)</sup> At the time of writing this report a Transport Bill proposing new arrangements for transport was being discussed in Parliament. As the ultimate text of the Bill has not yet been determined and the outcome of the Bill when it becomes an Act of Parliament cannot be predicted the reporter can only quote the circumstances existing under the Transport Act 1947.



by the liaison machinery set up in connection with the working agreements between the railways and the omnibus companies.

14. For *goods transport* almost the same development has taken place. However, in contrast with passenger transport the former four main line companies operated for the greater part their own fleets of vehicles for the collection and delivery of railborne traffic, together with a small proportion of throughout road haulage. Moreover they invested capital in road transport undertakings which were either wholly or partly owned by the railway companies. These undertakings were used to operate road transport services as an alternative to railway services.

By virtue of the Transport Act, 1947, the nationalised railways got full liberty of action as regards an unrestricted use of their collection and delivery fleets. On the other hand the former railway company interests in associated goods road transport undertakings passed to the R.H.E. The development of throughout road haulage service was left to this Executive which acquired the bulk of the long distance road haulage business in the country and also a great deal of short distance transport. The R.H.E. is now a substantial operator of specialist services for heavy haulage of abnormal, indivisible loads, household removals, meat, liquids in bulk and parcels.

In some respects close working between R.E. and R.H.E. was developed and among other things the R.E. curtailed its own collection and delivery establishment, relying substantially upon the R.H.E. for their marginal requirements.

The relations between R.H.E. and R.E. are governed (1) by a common responsibility to the B.T.C.; (2) by highly developed liaison machinery working at all levels, and (3) by a statement of policy concerning the integration of freight services by road and rail issued in June 1950.

Nevertheless the British Railways do not see from the railway point of view an advantage in the system of operating throughout road transport by the R.H.E.

It should however be taken into consideration that the implementation of the 1950 policy has been limited by the resistance of rail and road staff to changes which seemed to be against their interests and by other circumstances.

Summarizing it can be said that there are more or less independent separate organisations for rail and road transport, the R.E. and the R.H.E. These Executives are for all practical purposes separate authorities, though responsible to the British Transport Commission which operates bus services. The railways as they have no independent status are not allowed to participate in any way in road transport except that they are entirely free to operate collection and delivery services.

15. In the *London Transport Area* the L.T.E. operates railways as well as road passenger services and have been given full scope to run these services at their own will.

16. In *Eire* the nationalised railways and road services have not been placed in two separate organisations with very great independence, but the National Transport Undertaking (Coras Iompair Eireann) is operating both rail and road services under the same Board of Directors and a general manager, who are responsible for « the provision of an efficient, economical, convenient and properly integrated system of public transport for passengers and merchandise by rail, road and water ». Here also the railways as such are not allowed to participate in road transport, but the Board participates.

#### B. — The independent railway undertakings.

*What forms of organisation are they allowed to use and what forms have they adopted?*

17. The second group of railway undertakings of the other countries considered in this report are independent bodies. They are allowed to apply one or more forms of

organisation for the adoption of road vehicles and they have made various uses of this authority. Table 1 — as far as the replies permitted — shows the situation.

In this table the forms of organisation which they may use in the sense of « allowed, at least nor forbidden » and which they really use, have been indicated.

Analysing this table we see that :

1) many railway undertakings are authorized to use the three forms of organisation,

but that not all of them make use of this authority;

2) all railway undertakings are allowed to operate direct freight road services and nearly all of them do so;

3) many railway undertakings are authorized to contract with freight road transport undertakings and nearly all of them do so. However, they make far less use of their authority to contract for passenger road services;

TABLE 1.

Survey of allowed and adopted methods of organisation of road transport activities by railways.

Railways	Passenger traffic			Freight traffic		
	Contract (indirect)	Participation (semi-direct)	Direct operation	Contract (indirect)	Participation (semi-direct)	Direct operation
1. American Railroads ....	?	AU	?	AU	AU	AU
2. Ceylon Government Railway.....	AU			AU		AU
3. Danish State Railways	A	A	AU	A	A	AU
4. Egyptian State Railways		A			A	AU
5. Finnish State Railways	AU	AU	AU	A	AU	AU
6. Indian Railway Board	AU	AU	A	AU	AU	AU
7. Iranian State Railways	A	A	A	A	A	A
8. Netherlands Railways....		AU	A	AU	AU	A
9. New Zealand Government Railways .....	A		AU	A		AU
10. Nora Bergslags Railway	A	A	A	AU	A	A
11. Norwegian State Railways	AU	AU	AU	AU	A	AU
12. Rhodesia Railways ....		A	AU		A	AU
13. South African Railways	A	A	AU	AU	A	AU
14. Swedish State Railways		AU	AU	AU	AU	AU

A = Allowed or not forbidden.  
AU = Allowed and used.



4) many railway undertakings are also allowed or at least they have not been forbidden to participate in semi-direct operation, but only a few of them use this authority. They are the American Railroads, the Finnish State Railways, the Indian Railway Board, the Netherlands Railways, the Norwegian State Railways and the Swedish State Railways.

*Restrictions in the use of their authorities.*

18. From the above the conclusion can be made that all railway undertakings, as far as they are independent railway undertakings, are allowed to operate road vehicles, and that many of them are allowed to use various forms of organisation, but this does not mean that they are entirely free to use these authorities. On the contrary — they are, as far as could be determined, submitted to their national legislation, which regulates road transport, the Government issuing them licences to use road vehicles. However the standards for granting these licences and their conditions may differ. Therefore the question may be asked what is the position of the railways with respect to the national legislations. From the reports received it appears that this position is of a rather divergent character.

In the *United States* the railroads which are all private undertakings, are only allowed to operate road transport services by motor vehicles when they have been given authority by the Federal regulatory body, called the Interstate Commerce Commission (I.C.C.), and by the various state regulatory commissions, depending on whether the operations are interstate or foreign in nature or intrastate. The state laws do not seek to restrict or discriminate against motor transportation by the rail carriers.

In the Interstate Commerce Act — of which the Motor Carrier Act of 1935 forms part II — three sections are directly pertinent to road transport services by the railroads. The first of the sections provides for the granting of a Certificate of Public

Convenience and Necessity to road transport carriers who were operating as common carriers by motor vehicle at the time that the Act became a law. Pursuant to this provision, certificates were granted to numerous railroad carriers and their subsidiaries authorizing continuance of whatever type of operation they were engaged in. These certificates did not have any additional restrictions, placed upon such operations.

The second section provides for the issuance of Certificates of Public Convenience and Necessity authorizing *new* operations upon a showing that the applicant is willing and able to perform the service in question, and that the proposed service is and will be required by the present or future public convenience and necessity. No distinction is made in this section between railroad-owned or railroad-controlled applicants and other applicants. After the adoption of a national transportation policy in 1940 the I.C.C. have imposed some restrictions designed to limit the railroad or railroad motorcarrier subsidiaries to services which are auxiliary to or supplemental of the services of the railroad.

In 1951 the I.C.C. described the five conditions usually imposed on certificates authorizing auxiliary or supplemental service. These conditions are as follows :

1) a condition in general terms limiting the character of service which the applicant may perform to that which is auxiliary to or supplemental of the rail service of the railroad;

2) a condition limiting the authorized service to points that are stations on the rail lines of the railroad;

3) a condition which may take either of two forms : one form imposing a prior or subsequent rail haul condition and the other designating so-called key points;

4) the requirement that all contractual arrangements between the motor carrier and the railroad shall be reported to the I.C.C. and be subject to revision if and

as the I.C.C. finds necessary in order that such arrangements be fair and equitable to the parties;

5) the express reservation to the I.C.C. of the right in the future to make such further changes or modifications in the conditions as may be necessary in order to make certain that the motor carrier service remains auxiliary to or supplemental of the rail service.

The third section of the Interstate Commerce Act states that the I.C.C. may authorize the *transfer* of road transport or motor carrier operating authority, if it finds that the transaction is consistent with the public interest, provided, however, that if the applicant is a railroad or is railroad-controlled or affiliated, the I.C.C. must make an additional finding that the proposed transactions will enable such carrier to use service by motor vehicle to public advantage in its operations and will not unduly restrain competition. This discriminating restriction is applicable only to railroads.

Regarding this section in 1946 the I.C.C. expressed some concern over the projection of the railroads into highway transport service, principally by the purchase of operating rights of road service companies (independents). In many cases where the railroads or the railroad subsidiaries desired to acquire operating rights by purchases, the I.C.C. made its approval subject to such conditions as it might in the future impose in order to insure that future service under the acquired authority would be limited to that which is auxiliary to or supplemental of railroad service.

The I.C.C. further reported that some of the railway companies were rendering directly or through a motor carrier subsidiary a substantial all-motor service, at motor rates, in direct competition with their own rail service and with independent motor carriers. The I.C.C. thought such practices were not in keeping with the provisions of the third section. Therefore the I.C.C. of late has imposed substantially the same five conditions pre-

viously referred to for auxiliary and supplementary service. The I.C.C. has also reviewed cases and added such conditions where they were not imposed at the time of the disposition of the original applications. The Supreme Court of the United States has upheld this action taken by the I.C.C.

In conclusion it may be stated that in the United States every grant to a railroad or railroad affiliate of authority to operate as a common carrier by motor vehicle in interstate commerce, or to acquire such authority by purchase or otherwise, will be so conditioned as definitely to limit future service by motor vehicle to that what is auxiliary to or supplemental of train service; that is, to the transportation by truck of the rail traffic of the railroad, at railroad rates and on railroad bills of lading. The field for co-ordinated rail-truck and rail-bus operations seems to be limited at present by statutory restrictions primarily. The competence to make use of road services by direct operation or by subsidiaries will in this way be restricted in its effects to special cases of operation.

19. The *Danish State Railways* are authorized to the same extent as private companies and individuals to operate a road transport service, but regular road services may only be carried out, provided a concession is obtained through the county councils. Such concessions are granted for a certain number of years, usually 5, and the decision which company shall operate in the case where several applicants are interested in the same service, for instance when both the railways and private individuals apply to operate the same service, lies with the county councils.

In *India*, the liberty of action for participation in corporations is restricted by the Road Transport Corporations Act 1950, and in the case of participation in the road rail-associated companies by the India Companies Act, and is always subject to the provisions of the Motor Vehicles Act 1939, just as to the administrative approval of the Ministry of Railways. The Ministry



of Transport, which is separated from the Ministry of Railways, but directed by the same Minister of the Government, also controls the policy for road transport organisations themselves and as such controls road undertakings in which railways have participated.

The *Netherlands Railways* only operate passenger road transport via their subsidiaries, in which they are allowed to participate after consent of the Government. For the operation of regular and irregular services these subsidiaries are submitted to statutory regulations regarding passenger road transport. Until now the Government has consented to the participation in motor-bus companies in a very great part of the country. However, in the case of substitution of rail transport by road transport the railways do not have a priority for obtaining a licence for themselves or their subsidiaries. The licence for bus services is granted to the regional bus-company, this being in some cases a railway-subsiidiary, in other cases an independent undertaking.

For freight traffic the *Netherlands Railways* operate local and regional collection and delivery haulage services by their subsidiary haulage company. Moreover this subsidiary operates a long distance network of through road services at road transport tariffs and road transport bills of lading. Finally the railways themselves operate services for the collection and delivery of road-rail containers. The railways need a licence for all these services. As piece goods are not forwarded by rail on lines with low traffic, closing of such lines has not the effect of substituting rail by lorry transport.

The situation in the *Netherlands* is thus as follows: though the railways have been authorized to operate road vehicles they are for a further expansion dependent on Government policy and particularly on the licence-issuing authorities.

In *New Zealand*, liberty is restricted to the extent of licences granted by various district licensing authorities as constituted under the Transport Act, 1949. The

Railway Department is obliged to apply for licences in the same way as private operators.

In *Norway*, the liberty of action of the *Norwegian State Railways* is restricted, as Government approval is required. This is the same for the *Nora Bergslags Railway* in Sweden.

The *South African Railways* are submitted to the regulations of the Motor Carrier Transportation Act of 1950 so that they need a licence to operate road services.

In *Sweden*, where the State Railways use all three forms of organisation they are in principle on a level with the private transport undertakings for obtaining transport concessions from the authorities. In the case of bus services and to some extent also truck lines, which run parallel to existing railway lines, the railways have a certain advantage, as the concession when there are several applicants for it is — when no special objections can be raised — given to the undertaking, which already has an established road, railway or sea service along the route concerned. For long distance transport this advantage has hitherto proved to be of minor importance. However, in May 1953 a Royal Committee made a proposal which led to a more favourable position for the railways for long distance road traffic.

The liberty of action for concessions for road transport is restricted in so far as the railways must apply for a concession for every new busline they want to operate, just as for any number of trucks. As a rule the applications for licences have been granted. However, the licences received from the Government for the development of road transport services proved to be insufficient, especially during the first five post-war years, for the expansion desired.

From the picture of the situation in the various countries it may be concluded, that although the railways in general have the liberty to operate road vehicles and many of them have also the liberty to participate in road transport undertakings, their liberties are often restricted to a certain extent

by actual impediments of a legal or transport political character.

The authority to operate vehicles usually depends on the possession of a licence in conformity with the normal transport legislation and usually places the railways on a level with other undertakings. Moreover the railways usually require Government approval depending on the general transport policy. Sometimes there appears to exist strong opposition against the use of road vehicles by other than railborne traffic. This is plainly shown by the situation in the United States.

Therefore it is justified to conclude, that the railways in general do not have the liberties to adopt a new technique which other undertakings possess to meet the development of the technical possibilities and the requirements of their customers.

#### *Why motor vehicles are not used.*

20. The question may be asked why do some independent railway undertakings not use road vehicles. From the replies to the questionnaire it appears, that there is only one railway undertaking which does not operate any road service, i.e. the *Iranian State Railways*. The various reasons for this are all due to the circumstance that competition from road transport is not so strong that the railways need to proceed to road transport. The roads are so poor that long distance passenger transport is by preference carried out by the railways; in fact there exists a monopoly. Moreover there is sufficient freight for the capacity of the railways during the freight season; they provide the inland oil transport; the railways are mainly used for goods to be imported and exported and they transport all government materials. Though they are not in want of taking an active part in the struggle for competition, they are able to defend themselves against competition by an elastic tariff structure. They can obtain any legal authority according to the government policy, such as intervening in road transport or making contracts with interested

parties, but they do not consider it necessary.

#### *Why no participation.*

21. Some undertakings state why they do not make use of the mode of organisation to participate in road transport undertakings.

The *Ceylon Government Railway* which operates directly truck services and indirectly bus and truck services is not in need of participations, because they consider themselves safeguarded against the competition of bus and truck. The bus services are operated under a controlled monopolistic system with adequate safeguards for railway interests and for the development of rail road co-ordination. For goods transport the interests are also safeguarded because, apart from certain excluded traffic, the railway has a monopoly of transport for distances of 60 miles and over between places connected by the railway. Moreover, there is at the moment adequate transport for both rail and road.

The *Danish State Railways*, only using the method of direct operation, twenty years ago started to operate a few road transport services. They thought it quite natural to operate these services directly without the setting up of a special administrative body, i.e. without extra costs.

Though the network of road services grew steadily as the years went by, the railways so far have not found it expedient to adopt any of the other methods of operation.

The *Egyptian Railways* have withdrawn from participation, due to the unfavourable financial results they experienced with participation. The *South African Railways* which are operating directly bus and truck services and indirectly truck services, do not need participation as the road transport competition is not such as to justify participation. They prefer to operate their own road services as they are of the opinion that many advantages result from an independent and unified control of rail and road services and the greater co-ordination made possible thereby. The *East African*



*Railways and Harbours* do not seek to participate in road transport undertakings because the transport for hire and reward of passengers and goods by private enterprises is largely controlled by Government legislation.

To a large degree non-participation seems to be due to the small amount of competition the railways receive from road transport. Competition depends on the amount of protection, which the co-ordination policy of the Government offers the Railways. From the point of view of organisation the above mentioned railways apparently do not see any reason which might induce them to apply the method of semi-direct operation together with direct operation. The reason may be and the reporter can only say this hesitatingly, that many of these countries have backward areas which have to be developed by means of bus and truck services, so that it cannot be expected that independently organised road transport undertakings can operate remuneratively everywhere. Another reason may be the lack of a sufficient managerial and trained technical staff.

*Other nationalised undertakings with the status of a separate statutory organisation.*

22. Finally there is the question whether there exist nationalised undertakings other than railways which operate road transport services with the status of a separate statutory organisation. These are only found in *Great Britain*. It appears that in some countries (*Denmark, Finland and Sweden*) bus services are also operated by the Post Office. In *Sweden* the total length of route covered by these services amounts to 5 829 km. The State Railways created joint traffic facilities to a certain extent for the conveyance of passengers, luggage, express parcels and freight. The *Indian Railway Board* states that road transport services are operated by a separate statutory organisation in the State of *Bombay*. Some other States also intend to operate transport services by similar separate statu-

tory organisations. Moreover road transport services are operated departmentally by the States and there exist also co-ordinated rail and road companies in which the State, the railways and private operators participate. The semi-autonomous position of the road transport corporation constitutes valuable safeguards against such important public utilities being adversely affected by fluctuations in the electoral favours bestowed on political parties. Such autonomy is considered necessary in view of the two types of governmental control, i.e. the States and the Centre.

## Heading II.

### Actual participation.

#### CHAPTER I.

##### General.

##### *Motives of participation.*

23. *Question 6* asks about the motives for participation :

*If you are in a position to participate in road transport undertakings and if you take advantage of this, what are your motives for doing so?*

- a) *if for motives other than railway considerations, what are they?*
- b) *to meet the competitive conditions :*
  - ba) *by enabling the railway to control, through such participation, the existing transport market, yet at the same time retaining the road transport undertakings, competition being eliminated;*
  - bb) *by allowing the railway to obtain a dominating position in the inland transport market;*
  - bc) *by allowing the railway better to protect its position in the transport market relative to the competition from other road transport undertakings;*
  - bd) *by allowing the railway to take advantage of new developments in the transport field;*

c) *to enable the railway to make use of the two forms of transport — rail and road?*

d) *for other reasons?*

The motives for participation as well as for direct operation of the various railway undertakings (as far as these have been given), have been summarized in table 2.

From this survey it appears that three railway undertakings had or still have other than railway considerations for the operation of road transport services. Two of them apply the method of semi-direct operation in road transport and the third the method of direct operation. The *Norwegian State Railways* refer to social considerations, the *Rhodesia Railways* to the

TABLE 2.

Motives for participation in road transport undertakings and for direct operation.

Railway	Other than railway considerations	Motives of competition				To obtain rationalisation	For other railway motives
		controlling position	dominating position	better protection	new markets		
<b>A. Participation.</b>							
1. Finnish State Railways ...				×	×		
2. Indian Railway Board .....				×	×	×	
3. Netherlands Railways ...		×		×	×	×	
4. Norwegian State Railways ...	×	×	×	×	×	×	
5. Swedish State Railways ...	×			×	×	×	
<b>B. Direct operation</b>							
6. British Railways				×	×	×	
7. Ceylon Government Railway				×	×		
8. Danish State Railways ...		×				×	
9. New Zealand Government Railways ...				×			
10. Nora Bergslags Railway .....		×		×	×	×	
11. Rhodesia Railways .....	×						

× = appropriate.



opening of outlying districts in 1927, where animal drawn transport had to be substituted. The animals often suffered from diseases and for various reasons did not provide a reliable transport, so that the normal development of the country was retarded.

The change of motives in *Sweden* is notable. Competition by private road transport undertakings was once the main impetus to start activities in road transport with the object of protecting the position of the railways in the transport market. However, the State Railways now also fully appreciate the valuable use of road vehicles as a complement to and a substitute for rail services. They emphasize, that their activities in the field of road transport now have the primary object of providing an adequate transport system at a low aggregate cost within their traffic areas.

The competitive conditions are very important as an impetus for participation in road transport undertakings. The expectation of a better protection and the opening of new markets, door to door services included, are the most striking causes for this participation. Besides the motives for rationalisation are frequent.

The *Finnish State Railways* stated that their participation in « Pohjolan Liikenne O.Y. » has become necessary because of the growing competition and that its aim is to conserve traffic on the railways as much as possible. Obviously the railways have a great advantage when they are able to control the terminal transport and door to door services. This Administration endeavours to develop these combined services by making agreements with traders on a large scale.

The *Netherlands Railways* attribute their participation to the rapid development of road transport. This development still means that various transport tasks which formerly could only be performed by rail transport are now executed as well and even better — at least economically — by road transport undertakings. Thus the monopoly position of rail transport where

this still existed was ended radically and for good.

Because the fatal competition for the railways had not been adequately settled by the co-ordination policy of the Government and the railways themselves also wanted to take advantage of a new technique in order to improve their transport services and to enlarge their assortment of transport services, they have tried to find a solution by participating in existing road transport undertakings, or in road transport undertakings to be established.

The *Swedish State Railways* found that railway controlled road transport in connection with and complementary to rail transport involves considerable advantages for an economic operation. Such road services make it possible to co-ordinate rail and road transport within the areas of the railways.

We find the same motives with railway undertakings which apply direct operation. The *Ceylon Government Railway* stated that devoid of statutory rates and security, goods transport by road stands at a disadvantage. By including these cherished principles in feeder and collection and delivery services and by performing door to door transport at inclusive statutory rates, they attempt to meet competitive conditions.

The *Danish State Railways* run extensive bus services primarily to control the existing road transport parallel to the railway and, in cases where it is found useful, to be able to substitute trains by busses. They do not actually run goods road transport services, but as a corollary of their rationalisation they have introduced motor lorries for the conveyance of general goods between their town-stations and country-stations so as to avoid stopping of general goods trains at country-stations. These lorries have made it also possible to transport the goods direct to and from the consignee and consignor.

The *New Zealand Government Railways* do not view the use of road vehicles as a matter of a political principle but as one of sheer economic necessity arising from the

fact that railway control of road services on routes paralleling rail proved to be the only practicable method of restraining wasteful competition between road and rail.

*Achievements of participation.*

*Question 7. — To what extent do the undertakings in which you participate achieve these aims?*

24. From the answers to this question it appeared that although the railways have not entirely achieved their aims for the greater part they are well on their way to this. The position of the railways was strengthened in various respects. As to the receipts new markets were opened, transport from existing markets went to the railways and a further loss of traffic was halted. Moreover an uneconomic competition working out onerously on the tariff level came to an end. As to the costs important reductions could be obtained.

The development for the *Finnish State Railways* has been encouraging, but nevertheless private road transport has increased. The *Indian Railway Board* declared that their participation in road undertakings has to a large extent eliminated uneconomic competition between the two modes of transport. It will, however, take some time before the full value of participation in road undertakings can be appreciated.

The *Netherlands Railways* observed, that their participations in buscompanies have substantially contributed to a correct relation between rail and road transport. No less than 54 % of their passenger network lies within the regions of their subsidiaries. The activity of the subsidiary in freight traffic meant that a transport system could be built up which penetrates into all places of some importance, so that it obtained a unique position in the Netherlands for the transport of parcel goods. Moreover the introduction of the lorry gave them an opportunity to reorganise radically piece goods transport, the so called railhead system. The country is divided in 36 groups each with a railhead. Between these 36 points piece goods transport is

carried out by rail, so that a higher loading of waggons could be obtained. From these railheads goods are collected and delivered over the region. As a consequence of this system no less than 1 800 wagons or 27 % of the covered wagons were economized and a large number of stations were closed down for handling piece goods. This subsidiary also organised long distance through road services between 60 large centres. These services meant an enlargement of the assortment very much appreciated by the users especially for the conveyance of goods which for various reasons could better be transported by truck than by rail. The long distance services had a strong conserving influence on rail transport, as the transport needs of the users could still for the greater part be met by the railway undertaking.

The undertakings in which the *Norwegian State Railways* participated have partly achieved their aims.

The *Swedish State Railways* have met with some difficulties in establishing a firm road transport organisation, as private road transport undertakings had gained a strong position in substantial parts of the natural traffic areas of the railways, before the railways realised that an active policy had to be pursued in this sphere. However, the aim of the activities in this field — a co-ordination of rail and road transport within the traffic areas of the railway — has now been attained to a certain extent, especially for the busses. The position of the railways in regard to freight transport is much weaker.

Also the aims have more or less been achieved by the undertakings which do not participate, but use direct operation of road vehicles.

The tendency reported by the *Ceylon Government Railway* is that feeder services and collection and delivery services divert less than lorry load consignments and small traffic which are unremunerative to road operators, to the railway.

The *Danish State Railways* have gra-



dually taken over the majority of the routes which caused them a direct competition. The use of road vehicles in freight traffic is in an initial stage and therefore not fully developed. Nevertheless it has entirely fulfilled their expectations.

The *New Zealand Government Railways* stated in general that, under railway operation, the road services are co-ordinated with rail. The position is vastly different from that obtaining previously, when both passenger and goods road services operated in fierce competition with the train along practically every rail route. Further they emphasized the favourable consequences for passengers and consignors. In this connection they stated that the primary benefit of a large reduction of overlapping has been achieved. Had it not been for control through railway operation, there would have been a vast expansion of competitive road services and a large diversion of revenue from the Railways, which would then have become a greater burden on the consolidated fund than they are now. They have achieved substantial railway operating economies through substitution of suitable road services for certain train services, for example, the passenger accommodation on mixed trains and the public has benefitted directly from improved services and indirectly from improved railway finances. The fares charged on many of the purchased road passenger services could be substantially reduced. Timetable spacing and connections for intermediate passengers were improved. The large scale organisation of the railway road services can take the bad with the good and maintain in isolated and sparsely settled areas services which are not selfsupporting but none the less essential. A greatly improved service for small consignments goods traffic followed co-ordination of rail and road goods services.

#### *Kinds of transport services.*

*Question 8. — What kinds of transport services are provided by the undertakings in which you participate?*

25. The answers to this question are laid down in table 3. In this table some data have also been summarized of railway undertakings which do not participate in road transport undertakings, but use direct or indirect operation. As regards passenger transport it appears that the railway undertakings have not restricted themselves to the routes parallel to the railway, but are using the bus to a considerable extent, some undertakings to a very large extent, on routes not parallel to the railway. The operation of these lines, which mostly have the character of feeder lines, implies that the number of routes the undertakings serve has considerably been enlarged. The table clearly shows that in general parallel bus operation is used more to substitute certain individual trains than to substitute the complete passenger train service.

As regards freight traffic it appears that all railway undertakings use the truck for the carriage of parcels and small consignments (collection and delivery). Many, but not all railway undertakings, use the truck for the carriage of full load traffic. The truck just as the bus is only used to a very small extent in substitution of a railway which has been closed to traffic. It is also striking, that rather few railway undertakings use the truck for the technically mixed rail/road transport: operation with « pa » containers on special chassis, with railroad trailers, wagon carrying trailers and for effecting exceptional traffic (e.g. indivisible out-of-gauge loads) on routes parallel to the railway.

#### *Use of various methods.*

26. In table 4 some data have been summarized for the use of the various methods of operating road vehicles by the five railways participating in road transport undertakings. Comparing these data it is most striking, that many participating railways also use other operating methods for the same functions as for which they use the services of the associated road transport undertakings; in other words the associated

Kinds of service and length of route by road vehicles operated by railways.

Kinds of service	Subsidiaries						Direct operation						New Zealand Government Rail- ways (miles)	Nora Bergslags R. (km)										
	Finnish S.R. (km)			Norwegian S.R. (km)			Swedish S.R. (km)			British Transport Commission (miles)					Ceylon Govern- ment Railway (miles)			Coras Iompair Eireann (km)			Danish S.R. (km)			
	1	2	3	4	5	6	7	8	9	10	11	12												
<b>A. Passenger traffic.</b>																								
a) <i>Regular services</i>																								
1. on routes not parallel to railways . . . . .	×	29 163	6 834	×	11 000	28 500	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2. on routes parallel to railways for substituting . . . . .			2 167 (2)	×	400	600	×																	
a) certain individual trains	×		270	×	40	70	×																	
b) complete passenger train service . . . . .			164	×		180	×																	
c) complete service . . . . .		2 888	×	×	×	×	×																	
d) other services. . . . .	×	×	×	×	×	×	×																	
b) <i>Occasional bus services.</i>																								
a + b <i>Total</i> . . . . .	2 349 (1)																							
<b>B. Freight traffic.</b>																								
a) cartage of parcels and small consignments (collection and delivery). . . . .	×	3 171	6 119	×	×	×	×																	
b) cartage of full load traffic	×	617	×																					
c) operation with « pa » containers (on special chassis) . . . . .			×		×																			
d) operation with rail-road trailers. . . . .					×																			
e) operation with wagon-car-rying trailers . . . . .					×																			
f) exceptional traffic parallel to railways . . . . .				×	×																			
g) special traffic (e.g. removals) parallel to the railways . . . . .		×			×																			
h) in replacement of a railway closed to traffic. . . . .			550	×	60																			
i) other road services . . . . .		×	1 953 (3)	×	×																			
a t/m i total . . . . .	2 790 (1)																							

× = appropriate, but without statistical data.  
 (1) only route length, operated by subsidiary Pohjolan Liikenne.  
 (2) supplementary service parallel to railway.  
 (3) long distance through truck services.



T A B L E 4.

Types of services rendered with the various methods of operating road vehicles by railways participating in road transport undertakings

Type of service	Finnish State Railways				Indian Railway Board				Netherlands Railways				Norwegian State Railways				Swedish State Railways			
	D.O.	Ma	Mi	I.O.	D.O.	Ma	Mi	I.O.	D.O.	Ma	Mi	I.O.	D.O.	Ma	Mi	I.O.				
<b>A. Passenger traffic.</b>																				
<i>a. regular services</i>																				
— not parallel to the railway		×		×			×			×				×						
— parallel to the railway :																				
replacement of certain individual trains . . .		×								×		×		×						
— parallel to the railway :																				
in complete substitution of passenger train services . . . . .										×				×						
— parallel to the railway :																				
in substitution for all rail services . . . . .							×			×		×		×						
— other services . . . . .							×			×										
<i>b. occasional services on request</i>																				
<b>B. Freight traffic.</b>																				
<i>a. collection and delivery of parcels and small consignments . . . . .</i>																				
<i>b. idem, full load traffic . . .</i>																				
<i>c. « pa » containers on special chassis . . . . .</i>																				
<i>d. rail-road trailers . . . . .</i>																				
<i>e. wagon carrying trailers . .</i>																				
<i>f. exceptional traffic . . . . .</i>																				
<i>g. special traffic (e.g. household removals) . . . . .</i>																				
<i>h. in replacement of rail services</i>																				
<i>i. other road services . . . . .</i>																				

Legend : × = appropriate

D.O. = direct operation

Ma = majority participation

Mi = minority participation

I.O. = indirect operation (contract).

companies usually have not a technical monopoly. For this rich variation there are probably in general good reasons. In item 8, above for piece goods transport it has already been pointed out that there are many reasonable grounds to be advanced for the use of each of these three methods. Further it has been indicated that political considerations and the historical development should be taken into account as well. Only a detailed knowledge of the circumstances could explain the choice of the use of a certain method for a certain case.

As regards *passenger traffic* the following striking facts may be mentioned:

1) indirect operation of regular bus services not parallel to the railway only occurs with the *Finnish State Railways* and with the *Indian Railway Board*. All undertakings use the method of participation either by majority, or by minority. Only two railway undertakings, the *Norwegian* and the *Swedish State Railways*, also apply the method of direct operation;

2) for the replacement of certain individual passenger trains, beside the method of direct operation another method is also used in many cases;

3) complete substitution of passenger train services often takes place by direct operation of bus services. The *Finnish State Railways* also use semi-direct operation beside this method and the *Netherlands Railways* only apply the method of semi-direct operation;

4) operation of bus services as a substitution of all rail services does not frequently occur; the *Netherlands Railways* and the *Swedish State Railways* apply the semi-direct method for this, the latter also the method of direct operation;

5) occasional bus services are usually operated by bus companies in which the railways have participated. The *Norwegian State Railways* exclusively use the direct method for this purpose and the *Swedish State Railways* the direct and the semi-direct method.

As regards *freight traffic* it appears that:

1) for the collection and delivery of parcels and small consignments a definite rule cannot be indicated; many undertakings use one or more methods, among which the indirect operation by contract is usual. The same holds good for the collection and delivery of full load traffic in so far as this occurs;

2) exceptional traffic, special traffic and « other road services » are usually effected by an affiliated undertaking;

3) with the *Finnish State Railways* the affiliated company runs more kinds of services than is being done by direct operation;

4) with the *Netherlands Railways* and *Swedish State Railways* the services are mainly ensured by the affiliated truckcompanies in a rich variety. With the former direct operation does not occur, with the latter only by « other services ».

#### *Existing or new undertakings.*

Question 9. — *Have you participated in road transport undertakings already in existence or have you established new undertakings for the purpose? Have you a preference for one or the other of these methods. If so, why?*

27. The five railway undertakings, which have participated in road transport undertakings, have done this partly in existing and partly in newly established undertakings. A distinct preference for one of the two methods is not shown.

The *Finnish State Railways* in 1949 acquired the share majority of the Company Pohjolan Liikenne, which was formed in 1940 with State participation.

The *Indian Railway Board* has participated in two newly formed road undertakings and in two existing undertakings reorganised into tripartite companies. They prefer to participate in new undertakings, especially Road Transport Corporations, as these are statutory bodies free from political control.



The *Norwegian State Railways* participated in existing and in new undertakings and do not have a special preference for one of the two methods.

The *Netherlands Railways* — which have applied the two methods — particularly prefer to participate in existing undertakings as :

1) the already existing organisation of the undertaking can be used;

2) the existing enterprise knows exactly the demands made upon the transport system in a certain region, whereas a new, strange enterprise is ignorant of this and is only able to obtain this knowledge gradually.

From a humble start in 1920 the *Swedish State Railways* have since enlarged to an important degree their road transport services with new lines and to some extent also by the purchase of private road transport undertakings, in many cases in connection with the nationalisation of private owned railways. After becoming affiliated undertakings Biltrafik AB (GDG), Stockholm Läns Omnibus AB (SLO) and Svenska Lastbil AB (SLAB), they continued to be formally independent undertakings. No new undertakings have been established. However, at the moment the question is being examined whether there is a preference for road transport services under direct operation or under semi-direct operation.

*Co-operation with affiliated undertakings.*

*Question 10. — Does the railway co-operate with the road transport undertakings in which it participates in actually dealing with the traffic and if so in what spheres (timetables, rates and fares, conditions of carriage)?*

28. As it was to be expected all railway undertakings stated that they co-operate with the undertakings, in which they participate in an intensive and allround manner, particularly for the timetable, in which the frequency of the bus services

plays an important part — and also for the rates and the fares.

In *Sweden* the course of action for the affiliated undertakings is laid down by the respective boards of directors, to which the State Railway Administration as shareholder elects members, most of them being railway officials. During later years, however, even outside members with special qualities have been elected. On the other hand the Railway Administration has, no more than the *Indian Railway Board*, no direct ascendancy over the routine management of the operations of the undertakings, even if many questions are decided upon jointly by the officials of the undertakings and those of the railways.

The *Netherlands Railways* leave their affiliated companies as free as possible in their management. Only for bus services parallel to the railway is there close consultation with regard to the structure of the timetable and the tariff scales. The result of this co-ordination is however limited by Government approval of timetable and tariffs. The co-operation naturally tries to obtain an effective division of tasks and to prevent unreasonable competition. For goods transport there is also close co-operation. The transport of railborne piece goods by truck is effected on a railway bill of lading and at railway tariffs.

*Economical and statistical information.*

*Question 11. — Economical and statistical information to be given as under for each category of service set out in Question 8 :*

*Passenger traffic :*

- a) number of staff employed by the undertakings;
- b) number and capacity of vehicles;
- c) number of passengers carried per year;
- d) number of passenger kilometres per year;
- e) period for depreciation of vehicles.

*Freight traffic:*

- a) *idem* Sub Passenger traffic;
- b) number and unladen weight of vehicles;
- c) number of tons carried per year;
- d) number of net ton kilometres per year;
- e) *idem* Sub Passenger traffic.

## A. — PASSENGER TRANSPORT

(see table 5).

29. The most important undertakings in which the Administrations have participated are those of the *Indian Railway Board*, the *Swedish State Railways* and the *Netherlands Railways*. Of the Administrations with direct operation the bus services of the *Swedish State Railways*, the *New Zealand Government Railways* and the *Danish State Railways* are the largest. However, there still exist large differences in size as to the number of busses, viz from 2 060 busses of the *Indian Railway Board* to 65 busses of the *Nora Bergslags Railway*.

The density of traffic, the number of passengers transported per km route (column 4), also differs very much, i.e. from 11 542 passengers per km in the *Netherlands* to 1 442 passengers per km in *India*. The average number of passenger km per passenger (column 6) is very high in *India* for bus transport, i.e. 25.8 km and in *New Zealand* very small 1.8 km.

From the number of passengers carried per seat per year and the number of passenger km per seat (columns 9 and 10) as indices for the loading of the vehicles it appears that the *Netherlands* and *India* occupy the leading places. It is to be regretted that no passenger km are known of the bus services operated by the *Danish State Railways* and the *Nora Bergslags Railway* as the figures of the number of passengers carried per seat, which are higher than in *India*, indicate that important achievements have been obtained.

The depreciation periods for busses (column 11) differ very much. Usually

this period lies between 7 and 10 years. The short term of life, estimated in *India* at 4 years and in *Finland* at 5 years, is probably connected with the condition of the roads or climatic factors.

From the figures about the number of staff per 1 million passengers or 1 million passenger km (columns 13 and 14) we may conclude that *Denmark* and the *Netherlands* are the most favourable operators. If, however, we consider the number of staff per vehicle (column 15) then it appears that the figure of the *Netherlands* is very high, i.e. 3.6. This high figure is also due to the fact that in the *Netherlands* owing to the very high degree of occupation of the bus, there is usually a driver and a conductor or conductress on the bus. The reporter cannot give an explanation of the high figure of *India* as no data are at his disposal.

## B. — GOODS TRANSPORT

(see table 6).

30. According to the information received only the *British Railways*, the *Swedish State Railways*, the *Netherlands Railways* and the *New Zealand Government Railways* have an important apparatus at their disposal, though they differ very much as regards the number of vehicles, the staff (column 2) and the weight carried (column 3).

It is remarkable that the capacity per vehicle (column 5) with the *British Railways* is rather small, 2.2 ton. On the other hand the number of tons carried per ton capacity (column 6) is the highest. This may depend on the distance over which the goods have to be transported as well as on their quantity.

With regard to the number of tons carried per vehicle (column 7) the achievement of the services of the *Swedish State Railways* stands out above that in other countries. This is a consequence of the fact, that in *Sweden* the haulage services of the railways are also used for the delivery of wagon loads to the consignee's house.



TABLE 5.  
Statistical data about operation of bus services by railways.

Administration	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Number of vehicles	Length of route operated (km.)	Number of passengers carried per year	Number of passengers per km route operated	Number of passenger km per year $\times 1$ mln.	Passenger km per passenger	Number of seats $\times 1$ 000.	Number of seats per vehicle	Number of passengers carried per seat per year	Number of passenger km per seat per year $\times 1$ 000	Period of depreciation of vehicles in years	Number of staff	Number of staff per 1 mln passengers	Number of staff per 1 mln passenger km	Number of staff per vehicle.
<i>Participation.</i>															
1. Finnish State Railways ...	42	—	—	—	—	—	1.6	38.1	—	—	5	310 (1)	—	—	7.4
2. Indian Railway Board .....	2 060	52 000	75	1 442	1 937	25.8	67	32.5	1 119	28.9	4	13 862	184.8	7.2	6.7
3. Netherlands Railways....	1 381	9 400	108.5	11 542	1 425	13.1	57	41.3	1 900	25	8	5 010	46	3.5	3.6
4. Norwegian State Railways ...	140	—	6	—	86	14.3	5.1	36.4	1 176	16.9	8 to 10	400 (1)	66.6	4.7	2.9
5. Swedish State Railways ...	542	—	24	—	—	—	19	35.0	1 263	—	9	1 490	62	—	2.7
<i>Direct operation.</i>															
6 a. Swedish State Railways ...	1 430	—	45	—	—	—	50	35.0	900	—	9	2 600	58	—	1.8
6 b. Swedish State Railways (total)	1 972	40 000	69	1 725	750	10.9	69	35.0	1 000	10.9	9	4 090	59.3	5.5	2.1
7. Danish State Railways ...	500	4 500	22	4 889	—	—	15	30.0	1 467	—	6 2/3	850	38.6	—	1.7
8. New Zealand Government Railways ...	798	6 000	24.5	4 083	43	1.8	20	25.1	1 225	2.2	6 2/3	1 500	61.2	34.9	1.9
9. Nora Bergslags Railway.....	65	1 000	3.5	3 500	—	—	2.4	36.9	1 458	—	14 to 20	145	41.4	—	2.2

(1) together with freight traffic.

TABLE 6.  
Statistical data about operation of truck services by railways.

Administration	1	2	3	4	5	6	7	8	9	10	11	12	13
	Number of vehicles	Number of staff	Number of tons carried per year × 1 000	Carrying capacity of vehicles in tons	Carrying capacity per vehicle in tons	Number of tons carried per ton capacity	Number of tons carried per vehicle	Number of staff per vehicle	Number of staff per 1 000 tons carried	Number of ton kilometres per year × 1 mln.	Number of kilometres per ton	Number of ton kilometres per vehicle × 1 000	Period of depreciation of vehicles in years
<i>Participation.</i>													
1. Finnish State Railways.....	83	310 (1)	70	—	—	—	843	3.7	4.4	—	—	—	5
2. Indian Railway Board.....	—	182	11	—	—	—	—	—	16.5	0.9	81.8	—	4
3. Netherlands Railways .....	868	1 500	1 260	3 710	4.3	340	1 452	1.7	1.2	—	—	—	8
4. Norwegian State Railways (3)	45	600 (2)	50	—	—	—	1 111	13.3	12	1.5	30	33.3	8 to 10
5. Swedish State Railways (4)	743	1 341	—	—	—	—	—	1.8	—	—	—	—	7
<i>Direct operation.</i>													
6 a. Swedish State Railways	173	206	—	—	—	—	—	1.2	—	—	—	—	7
6 b. Swedish State Railways (total) (4) .....	916	1 547	3 000	—	—	—	3 275	1.7	0.5	40	13.3	43.7	7
7. British Railways (5) .....	25 000	20 000	25 500	55 000	2.2	464	1 020	0.8	0.8	—	—	—	10 to 12
8. Ceylon Government Railway	7	25	—	—	—	—	—	3.6	—	—	—	—	—
9. Danish State Railways ...	85	60	70	390	4.6	180	824	0.7	0.85	—	—	—	6 2/3
10. New Zealand Government Railways .....	303	225	389	—	—	—	1 284	0.7	0.6	5.3	13.6	17.5	6 2/3
11. Nora Bergslags Railway ..	8	10	3	—	—	—	375	1.3	3.3	—	—	—	20 to 25

(1) together with passenger traffic.

(2) of which 400 common with passengers.

(3) without collection and delivery.

(4) A.B. Svenska Godscentraler excluded.

(5) Cartage of parcels, small consignments and full load traffic only.



TABLE 7.

Data of bus services operated by railways, of railway passenger traffic and of total bus traffic.

Data	Danish State Railways	Netherlands Railways	New Zealand Government Railways	Nora Bergslags Railway	Norwegian State Railways	Swedish State Railways (total)	Indian Railway Board
1. <i>Number of passengers</i> (× 1 000 000)							
a) by rail bus services	22	108.5	24.7	—	6	69	75
b) by rail services .....	100	157	21.3	—	38.3	132	1 307
c) by bus services .....	—	231.2	109.0	—	—	330	—
2. <i>Number of passenger km</i> (× 1 000 000)							
a) by rail bus services	—	1 425	43.4	—	86	750	1 938
b) by rail services .....	—	6 291	435.8	—	1 519	6 355	67 144
c) by bus services .....	—	—	—	—	—	3 300	—
3. <i>Receipts</i> (× 1 000 000)							
a) of rail bus services	—	fl. 39.5	£ 2.0	—	—	kr 80	Rs 59
b) of railways .....	—	fl. 185	£ 2.3	—	—	kr 376	Rs 992
c) of bus services .....	—	—	£ 5.5	—	—	kr 480	—
4. <i>Number of staff</i> (× 1 000)							
a) of rail bus services	850	5.0	1.5	—	—	4.1	13.9
b) of railways .....	—	35.1 (1)	—	—	—	70.9 (1)	—
c) of bus services .....	—	—	—	—	—	—	—
5. <i>Length of route operated</i> (× 1 000)							
a) of rail bus services	4.5	9.4	6.0	1.0	—	40	52
b) of railways .....	2.6	2.5	3.5	0.172	—	15	55
c) of bus services .....	30	19.5	—	—	—	100	—

(1) Common with freight traffic.

The depreciation periods of lorries (column 13) in general do not differ from those which the various administrations use for busses. Only with the *Swedish State Railways* the depreciation period of lorries is 2 years shorter than for busses.

Question 12. — *In the case of the road transport undertakings in which the railways participate, what is the size of the road traffic carried, expressed as a per-*

*centage of the traffic carried by rail and also, if possible, of the total road traffic carried by the professional road carriers in your country?*

*Passenger traffic :*

- a) *number of passengers;*
- b) *number of passenger kilometres;*
- c) *receipts;*
- d) *number of staff;*
- e) *length of routes operated.*

*Freight traffic:*

- a) number of tons;
- b) number of net ton kilometres;
- c) *idem*;
- d) *idem*.

## A. — PASSENGER TRAFFIC.

1. — Comparison of bus transport services of the railways with rail transport (see tables 7 and 8).

cerned, that the networks operated by the bus services, compared with those of the railways, are of such an importance, that they are equal to (*India*) or much larger than the networks operated by the railways. With the *Nora Bergslags Railway* the length of the railway is even insignificant compared with that of the bus network.

With regard to the number of passengers carried (column 2) the operation of bus services (the *Nora Bergslags Railway* and

TABLE 8.

Road passenger traffic of railways in percentages of railway passenger traffic.

Administration	Length of route operated	Number of passengers	Number of passengers per km route operated	Number of kilometres per passenger	Number of passenger kilometres	Receipts per passenger kilometre	Receipts
	1	2	3	4	5	6	7
<i>Participation.</i>							
1. Indian Railway Board ...	95	6	6	50	3	200	6
2. Netherlands Railways ...	376	69	18	34	23	93	21
3. Norwegian State Railways	—	16	—	36	5	—	—
4. Swedish State Railways (total) .....	267	52	20	23	12	180	21
<i>Direct operation.</i>							
5. Danish State Railways..	173	22	13	—	—	—	—
6. New Zealand Government Railways .....	171	116	67	9	10	870	87
7. Nora Bergslags Railway	581	1 000	—	—	—	—	600

31. In the comparison the length of the networks operated by bus and by rail, the passengers carried, the passenger km completed and the receipts are involved.

Starting from the length of the network (column 1, table 8) it appears from the answers given by the administrations con-

the *New Zealand Government Railways* excluded) falls, however, below the railways. In *New Zealand* too, the ratio of the number of passengers carried is more unfavourable than the ratio of the length of the network. This phenomenon is due to the well known fact, that bus services

TABLE 9.

Road passenger traffic of railways in percentages of total road passenger traffic.

Administration	Length of route operated	Number of passengers	Number of passenger km	Receipts
	1	2	3	4
1. Netherlands Railways . . . . .	48	48	—	—
2. New Zealand Government Railways	—	23	—	36
3. Swedish State Railways . . . . .	40	21	23	17

are especially operated on less crowded routes and in the country, where owing to its rather small capacity, the bus is the obvious means of transport. This is clearly seen from the ratio for the density of passenger traffic per km route operated, which is very low (column 3) particularly in India.

As the average length of route covered by bus passengers (column 4) lies considerably below that covered by railway passengers, the significance of bus transport with respect to rail transport, by the standard of the passenger km completed, is much smaller and varies only from 3 to 23 % of rail transport (column 5).

Finally it appears from the ratio figures of the fare per passenger km (column 6) that the bus fares are considerably higher than the railway fares, so that owing to this the ratio figures of the receipts of rail and bus transport (column 7) are again higher. In *New Zealand* there exists a particularly large difference between the fares per passenger km of rail and bus transport.

2. — *Comparison of the bus transport operated by the railways with the entire bus transport* (see table 9).

32. With regard to the ratio of the railway bus transport to the entire bus trans-

port data are only available from *New Zealand*, *Sweden* and the *Netherlands*.

From these it appears that the transport effected by the railway bus services, is very important in these countries. It is striking that in *Sweden* the percentage of the length of the network (column 1) is higher than that of the passengers carried (column 2), which indicates that the bus services operated by the railways cover more routes on which there is very little traffic than the other bus services.

From the circumstance, that the share of the railway bus services in the total transport receipts is much smaller (column 4) than in the passenger km (column 3) it follows, that the fares of the Swedish railway bus services are lower than those of the other bus services.

The higher percentage of the receipts than of the passengers carried in *New Zealand* suggests that in this country just the opposite is the case, which is also made plausible by the exceptionally high ratio with respect to the railway fares mentioned in table 8, column 6.

## B. — GOODS TRANSPORT.

1. — *Comparison of the railway truck services with rail traffic* (see tables 10 and 11).



TABLE 10.

Data of truck services operated by railways, of railway freight traffic and of total truck traffic.

Data	Danish State Railways	Indian Railway Board	Netherlands Railways	New Zealand Government Railways	Norwegian State Railways	Swedish State Railways
1. <i>Number of tons</i> (× 1 000 000)						
a) by rail truck services	0.07	0.01	1.3	0.4	0.05	3
b) by rail services .....	6.9	83	22.6	9.8	13.2	42
c) by truck services ....	1.2	—	151	—	—	55 (1)
2. <i>Number of ton kilometres</i> (× 1 000 000)						
a) by rail truck services	—	0.9	—	5.3	1.5	40
b) by rail services .....	—	—	3 256	1 720	1 382	9 373
c) by truck services ....	—	—	1 247	—	—	1 240 (1)
3. <i>Receipts</i> (× 1 000 000)						
a) of rail truck services	—	Rs 0.3	—	£ 0.35	—	Cr 30
b) of rail services .....	—	—	fl. 129	£ 17.—	—	Cr 615
c) of truck services ....	—	—	—	£ 18.3	—	Cr 457 (1)
4. <i>Number of staff</i> (× 1 000)						
a) of rail truck services	—	0.2	1.5	0.22	—	1.5
b) of rail services .....	—	—	35.1 (2)	—	—	70.9 (2)
c) of truck services ....	—	—	—	—	—	—

(1) Professional carriers (incl. railways).

(2) Included passenger traffic.

33. From the ratio of tons transported (column 1, table 11) it appears that even in countries where the railways have a rather extensive road transport apparatus at their disposal, the amount of goods transported by it only forms a very small percentage of the transport effected by the railways. This is a consequence of the fact, that the use of road transport vehicles by the railway is mainly restricted to the transport of piece goods.

As the average number of km per ton (column 2) is considerably smaller with road transport than with rail transport the ton km of road transport are only a fraction of those of rail transport (column 3).

The tariff per ton km for the transport of piece goods being higher than for other transport, the significance of road transport with respect to the receipts is again more important (column 4).

TABLE 11.

Road freight traffic of railways in percentages of railway freight traffic.

Administration	Tons carried	Number of km per ton	Number of ton km	Receipts
	1	2	3	4
1. British Railways . . . . .	8.8	—	—	—
2. Danish State Railways . . . . .	1	—	—	—
3. Netherlands Railways . . . . .	5.5	—	—	—
4. New Zealand Government Railways	4	7.4	0.3	2
5. Norwegian State Railways. . . . .	0.4	30	0.11	—
6. Swedish State Railways . . . . .	7	6	0.4	5

2. — *Comparison of the extent of railway truck services with respect to the total truck services.*

Through road services occur more often in passenger transport than in goods transport.

34. Only a few comparative figures from Sweden, Denmark, New Zealand and the Netherlands are at our disposal. In Sweden the contribution of railway truck services to the total tonnage transported by road transport amounts to 5 %, in Denmark to 6 % and in the Netherlands only to 1 %. The proportions in ton km and total proceeds are in Sweden 3 and 7 % respectively. In New Zealand the proceeds are 1.9 % of those of the total truck transport.

Comparing the above mentioned percentages of the Netherlands, New Zealand and Sweden with the percentages of the shares which the railway bus services have in these countries in the total bus transport (table 9), it appears that the percentages are much higher for bus transport.

From this we may conclude, that the railways in these countries have been much more active for passenger traffic than for goods traffic. In goods traffic the activity is mainly restricted to railborne traffic.

## CHAPTER 2.

### Methods of participation.

*Questions 13 to 18 inclusive.*

13. *In what way do you participate in road transport undertakings?*
  - a) *by contract reserving certain spheres for the railways?*
  - b) *by direct participation in the management?*
14. *In the case of participation by contract what forms does this actually take?*
  - a) *a contract under which the undertaking accepts an obligation to provide certain services for which payment is made?*
  - b) *a partnership agreement under which the railway receives a proportion of the receipts and shares in the risks of the service?*

- c) *other conditions of contract affording advantages to the railway.*
15. *In the case of direct participation in the management of the road transport undertaking, what form does this take?*
- the right to appoint the members of the board of directors?*
  - the right to appoint the management?*
  - other rights — if so what are they?*
16. *In the case of participation in the management by what method is this effected:*
- the holding of shares in the undertaking?*
  - the granting of loans?*
  - the hiring of equipment or premises?*
  - other forms of participation; if so, what are they?*
  - a combination of these different methods?*
- State if possible, the relative importance of these different means.*
17. *In the case of participation in the capital of the undertaking:*
- does the investment represent a majority, equal or minority holding?*
  - if there are other shares, are these held by private individuals, private undertakings, the government or government undertakings? If so, in what proportion?*
18. *Is your right to participate in the management favoured by:*
- the status of the railway undertaking (private enterprise, nationalised or a mixed system)?*
  - the policy in regard to co-ordination adopted by the government authorities?*

35. From the answers received, it appears

that all five railway undertakings <sup>(1)</sup> are represented in the Board of Management or in the Board of Directors of the undertakings in which they participate. Usually they appoint all members of these organs, sometimes only some representatives. With all undertakings this right to appoint is vested in the holding of shares, with the *Finnish State Railways* and the *Indian Railway Board* also in the hiring of equipment and premises and with the latter moreover in the granting of loans.

The *Finnish State Railways* and the *Swedish State Railways* have only majority participations, the *Indian Railway Board* and the *Norwegian State Railways* minority participations. The *Netherlands Railways* mainly possess majority participations, but also some minority participations.

If the railways do not have total participations, the other shareholders come from various categories. The *Finnish State Railways* have as co-shareholders in Pohjolan Liikenne the Ministry of Trade and Industry for 22 % and certain organisations of retail business and the timber industry for 8 %. The co-shareholders of the *Indian Railways* are private individuals, private undertakings, the government and government undertakings. Of the subsidiaries of the *Netherlands Railways* 82 % of the share capital is in the hands of the railways, 8 % is owned by the government, 7 % by regional authorities and 3 % by private individuals.

For the *Norwegian State Railways* 1/3 of the shares of their subsidiaries are in the hands of private undertakings. The *Swedish State Railways* possess all shares of G.D.G., S.L.A.B. and S.L.O. and 50 % of the shares of A.S.G.

36. Only the *Finnish State Railways* are of the opinion that the right to participate in the management is favoured by their status as a nationalized undertaking. The

<sup>(1)</sup> I.e. *Finnish State Railways*, *Indian Railway Board*, *Netherlands Railways*, *Norwegian State Railways* and *Swedish State Railways*.



*Netherlands Railways*, the *Norwegian* and the *Swedish State Railways* are of a different opinion.

Only the *Finnish State Railways*, the *Indian Railway Board* and the *Norwegian State Railways* mention that they are favoured by the co-ordination policy of the government. The *Finnish State Railways* are of the opinion that from the point of view of co-ordination, co-operation with a road transport company can only be favoured and so far the government authorities have been of this opinion. The *Netherlands Railways* share the opinion that co-ordination of transport is favoured by participation in road transport undertakings, but at the same time they draw attention to the fact that they have been stimulated to participate, as the co-ordination policy of the Government provided them insufficient protection.

37. Nowhere has making a contract to carry out some services led to a control of or participation in the management of the contracting road transport undertaking.

The contractual obligations usually do not extend further than operating certain services at a fixed rate. The *Ceylon Government Railway* and the *Netherlands Railways* stipulate in the contract that the contracting party will not compete with the railways. Moreover the contracting parties of the *Netherlands Railways* have the obligation that goods which are offered to them for transport to destinations outside their area will be exclusively offered to the railways for conveyance in transit and not to other transporters.

### CHAPTER 3.

#### Organisation of the participation.

##### *Questions 19 to 21 inclusive.*

19. *Is there any special organisation responsible for securing co-ordination between the railway and the road transport undertakings in which you participate? If so, what is this organisation and what are its functions?*

20. *Have the different road transport undertakings in which you participate a common organisation independent of the railway responsible for the co-ordination and rationalisation of their activities? How does this organisation work and what is the field of its activities?*

21. *Are the road transport undertakings in which you already participate regarded as large, average or small concerns? To which type of undertaking would you give preference if the choice still has to be made?*

38. The question whether there exists a special organisation responsible for securing co-ordination between the railway and its subsidiaries is answered in the negative by the *Finnish State Railways* and the *Swedish State Railways*. The co-ordination in *India* — where the railways possess a minority participation — is externally regulated by government authorities, i.e. the Central Board of Transport and a Transport Advisory Council and the Boards of Transport in the various States. A special department of the *Netherlands Railways* is in charge of the external co-ordination between rail and road transport and with the internal co-ordination, i.e. with the division of tasks between the railways and their subsidiaries. They advise the Management of the Railways and of the subsidiaries, look after the interests of the subsidiaries for the issue of licences and draw up rules for the supply of transport on lines running parallel to the railway. Also with the *Norwegian State Railways* there exists a special organisation for co-ordination between railway and road transport subsidiaries.

39. Only the *Netherlands Railways* have two organisations which co-ordinate certain activities of their subsidiaries. The first organisation is an incorporated undertaking for general and heavy repairs of their joint bus stock. The second organisation is an association of the managers of the subsidiaries, looking after their

joint interests : e.g. joint purchase and joint staff policy. This association gives juridical advice to its members. At the same time it acts as a centre for mutual discussion between the members in the operational-technical field.

40. As regards the size of the subsidiaries: the *Indian Railway Board* participates in all sizes, but has a special preference for large undertakings. The *Finnish State Railways* participate, in average undertakings, just as the *Norwegian State Railways*. They have no special preference for a certain type of size. Neither have the *Swedish State Railways* which operate the largest enterprises in the country. On the other hand the *Netherlands Railways* which possess large subsidiaries have a preference for large undertakings, as large undertakings are cheaper to operate than smaller ones.

### Heading III.

#### Results of participation.

#### CHAPTER I.

#### Financial results.

#### *Questions 22 to 27 inclusive.*

22. *What is the amount of your investments in the road transport undertakings in which you participate? Give details of:*

- a) *shares subscribed;*
- b) *loans granted;*
- c) *equipment hired;*
- d) *contributions in kind?*

23. *What is the relationship of these investments to the total investments of the railway undertaking?*

24. *What was the amount of the annual operation receipts and expenditure of the road transport undertakings for each year from 1948 to 1951 inclusive? (If possible, give separate figures for freight and passenger traffic.) What*

*was the state of the profit and loss account for each of the same years?*

25. *What was the amount of the annual operating receipts and expenditure for the railway for each year from 1948 to 1951 inclusive? (If possible, give separate figures for passenger and freight traffic.)*

*What was the state of the profit and loss account for each of the same years?*

26. *What is the total amount of the dividends received from the road transport undertakings or of the subsidies granted to them?*

27. *Does participation in road transport undertakings result in a worsening or an improvement of the financial results of the railway and to what extent?*

#### *Investments.*

41. The investments in subsidiary road transport undertakings and their ratio to the investments in railways have been summarized in table 12. At the same time investments in the railways are mentioned.

From these figures it appears that the investments of railways in subsidiary road transport undertakings and in directly operated road services form only a small part of the investments in the railways themselves.

#### *Receipts, expenditure, profit and loss.*

42. A survey of the receipts, expenditure and profit and loss of road transport subsidiaries, compared with those of the railways (questions 24 and 25) is given in table 13.

From table 13 it appears that all undertakings, except one, in which the railways have participated, usually make a profit. These figures also show that the receipts of the subsidiaries, compared with those of the railways, are rather small. With the *Finnish State Railways*, the *Indian Railway Board*, the *Norwegian State Railways* and the *Swedish State Railways* they are not more than 4 % as a maximum.

TABLE 12.  
Investments in road transport undertakings.  
(× 1 000 000 of the national currency)

<i>Railway</i>	<i>Money unit</i>	<i>Investment in subsidiaries</i>	<i>Investment in railways</i>	<i>Investments in subsidiaries in % of railway investments</i>
<b>A. Participations</b>				
Finnish State Railways .....	Finnish Marks	12	—	insignificant
Indian Railway Board .....	Ruppees	31	—	»
Netherlands Railways .....	Guilders	21	1 750	1.2
Norwegian State Railways ....	Norwegian Crowns	6	1 600	0.4
Swedish State Railways .....	Swedish Crowns	24	1 231	1.9
<b>B. Direct management</b>				
Swedish State Railways .....	Swedish Crowns	42	1 231	3.4
Danish State Railways .....	Danish Crowns	18.2	720	2.5
New Zealand Government Railways .....	Pounds	2.8	88	3.2

*Financial benefits.*

43. The total amount of dividends received from road transport undertakings (question 26) have been summarized in table 14. Subsidies were not granted.

The figures of the dividend received, which only reveal the profit distributed and consequently give no picture of the real profit, show that the road transport undertakings in which the railways have participated, have to a modest extent made a contribution to the revenue of the parent railway undertaking.

All railway undertakings stated in reply to question 27 that their participation in road transport undertakings had a favourable influence on the financial position of the railway. This favourable influence — the *Netherlands Railways* stated — is noticeable for the receipts in so far as a rational division of tasks has been achieved and for the expenses by the substitution of

a great part of rail piece goods traffic by truck services.

CHAPTER 2.

Other results.

*Questions 28 to 34 inclusive.*

28. *What are the results of the participation of the railway in road transport undertakings from the national economic point of view :*
- has it brought about an improvement in the public transport services by rail and road?*
  - has it facilitated the organisation by the government of co-ordination between the different means of transport?*
  - has it eased relations between the railway and the road transport undertakings?*



TABLE 13.

Operating results of road transport subsidiaries, compared with those of railways  $\times 1\ 000\ 000$  of the national currency.

Administration	Year	Receipts			Expenditure			Profit		Loss	
		Railway	Road subs.	%	Railway	Road subs.	%	Rail-way	Road subs.	Rail-way	Road subs.
A. <i>Subsidiaries</i>											
Finnish State Railways ..	1948	13 642	118	0.9	11 952	129	1.1	1 690			
	1949	12 143	110	0.9	13 097	117	0.9			936	11
	1950	13 200	222	1.7	15 697	221	1.4		1	2 497	7
	1951	21 236	339	1.6	20 505	337	1.6	731	2		
Indian Railway Board .....	1948/9	1 851	8.9	0.5	1 479	7.5	0.5	372	1.4		
	1949/50	2 053	25.4	1.2	1 639	22.3	1.4	414	3.0		
	1950/1	2 112	45.5	2.2	1 695	43.0	2.5	417	2.5		
	1951/2	2 386	58.4	2.5	1 850	54.3	2.9	536	4.1		
Netherlands Railways ..	1948	289	54.5 (1)	18.8				×	×		
	1949	286	50.5 (1)	17.5				1	×		
	1950	317	50.5 (1)	15.9				1	×		
	1951	332	53.2 (1)	16.0				×	×		
Norwegian State Railways ...	1948/9	259	6.3	2.4	319	5.6	1.8		0.8	59	
	1949/50	283	7.4	2.6	324	6.8	2.1		0.6	41	
	1950/1	307	8.1	2.6	360	7.9	2.2		0.2	53	
	1951/2	347	9.1	2.6	406	9.1	2.2		0.0	59	
Swedish State Railways	1948	800	29 (2)	3.6	767	29 (2)	3.8	33	0.3 (3)		
	1949	844	34 (2)	4.0	830	34 (2)	4.1	15	0.4 (3)		
	1950	884	39 (2)	4.4	880	39 (2)	4.4	3	0.4 (3)		
	1951	1 081	46 (2)	4.3	1 092	46 (2)	4.2			11	0.1
B. <i>Direct management</i>											
Swedish State Railways (S. J. Biltrafik)	1948	800	37	4.6	767	32	4.2	33	5		
	1949	844	44	5.2	830	38	4.6	15	6		
	1950	884	50	5.7	880	45	5.1	3	5		
	1951	1 081	59	5.5	1 092	58	5.3		1	11	
Danish State Railways (passenger traffic (4)) .	1948/9	339	15.1	4.5	387	12.9	3.3		2.2	47	
	1949/50	338	18.4	5.4	403	16.3	4.0		2.1	65	
	1950/1	376	21.9	5.8	422	18.6	4.4		3.3	46	
	1951/2	426	25.0	5.9	487	21.5	4.4		3.5	61	
New Zealand Government Railways ..	1948	17.1	1.7	9.9	20.8	1.7	8.2		0.1	3.7	
	1949	18.6	1.9	10.2	22.4	1.9	8.5		×	3.8	
	1950	19.5	2.0	10.3	23.3	2.1	9.0			3.8	0.1
	1951	22.1	2.1	9.5	25.0	2.1	8.4			2.9	×
Nora Bergslags Railway....	1948	3.6	2.0	56					×		
	1949	3.6	2.2	61					×		
	1950	3.3	2.4	73					×		
	1951	4.6	2.7	59					×		

Appropriate.

Bus services only.

Without A. S. G.

Net profits of A.S.G. 0.1; 0.2; 0.2; 0.2.

Exact accounts for lorries could not be made; the total expenditure amounted to  $\pm 1\ 000\ 000$  Da. Cr.

TABLE 14.

Total amount of received dividends.  
(× 1 000 000 of the national currency)

	1948	1949	1950	1951	Year average
Finnish State Railways .....	0.0	0.0	0.0	0.0	0.0
Indian Railway Board .....	0.1	0.3	0.4	0.7	0.4
Norwegian State Railways .....	0.0	0.0	0.0	0.0	0.0
Swedish State Railways.....	5.0	6.7	5.1	1.0	4.4

29. *Has the economic position of the railway been strengthened as a result of its participation in road transport undertakings :*

- a) *by giving the railway a dominating position in the transport market?*
- b) *by protecting the railway more effectively against road competition?*
- c) *by opening up new developments and in particular enabling the railways to offer the public a wider range of services.*

30. *If participation resulted from the need to rationalise railway operation has it reduced the cost of movement of traffic transferred from the railway to the road services?*

31. *What are the economies which have been achieved through the subsequent re-grouping of small road transport undertakings following railway participation?*

32. *Do you consider that participation has achieved its aim? If not, state for what reasons?*

33. *If you consider that railway participation has achieved its aim, are you contemplating extending such participation still further?*

- a) *if so, in which direction?*
- b) *if not, why?*

34. *If on the contrary you feel that participation has not achieved its aim, what are the reasons for this failure and what steps are you considering taking to overcome the difficulties encountered?*

#### *National economic benefits.*

44. All railways in their replies to question 28 are of the same opinion that the participation in road transport undertakings has, from an economic point of view, improved the rail and road public services. The *Swedish State Railways* state that from a social economic point of view, the expansion of their road services has brought about a more rational use of the rail and road transport resources. A more effective use of staff, rolling stock and other equipments is the gain obtained by this rationalization. From the consignors' point of view the participation has involved improved public transport services due to the co-ordination of rail and road that has been achieved. The *Netherlands Railways* point out, that only the use of the truck via their subsidiary in freight traffic has enabled them to cover the Netherlands with a dense network of transport services and consequently to offer to the consignors a unique supply of transport of a national character for which there appears to be an urgent need.

All railways are of the opinion, that participation in road transport under-

takings has facilitated the co-ordination between the different means of transport.

With regard to the question whether the participations have facilitated the relations between railway and road transport undertakings the opinions differ. In *Finland* and in *Norway* the question is answered in the negative, in *Sweden* and in *India* in the affirmative. The *Netherlands Railways* answer the question in the affirmative in so far as, on account of their participation, they are able to express their opinion in group organisations of the road transport undertakings and to take note of the problems, which promotes mutual understanding. On the other hand in the private undertakings in the road transport sector there exists a strong opposition against the participation of the Government in road transport by means of the subsidiaries of the *Netherlands Railways*.

#### *Strengthening of the railway position.*

45. One of the results of participation moreover is, that the economic position of the railway has been strengthened; this in reply to question 29. The *Swedish State Railways* observed, that for a long time they have been the dominating transport undertaking in their country and by means of participation have been able to prevent to a certain extent a diversion of traffic from rail to road, when not justified from a general point of view. The *Netherlands Railways* are of the same opinion.

All railways are also more effectively protected against road competition. Participation moreover gave them the possibility of offering the public a wider range of services.

#### *Rationalization of operation.*

46. If participation was stimulated in order to rationalize railway operation, this aim has been achieved, also with the result that the cost of movement of traffic transferred from rail to road services has been reduced. The *Finnish State Railways*

declared that, especially the cost of part load traffic has been reduced. The *Netherlands Railways* e.g. have been able to combine a great number of express and freight goods offices and to reduce considerably the number of goods train kms which also involved a large reduction of the number of shunting hours. Moreover the number of covered wagons could be reduced by 27 %. The *Danish State Railways* gave the example that the substitution of a long distance night train between Aalborg-Frederikshavn by a double bus service resulted in a saving of 120 000 Danish Crowns annually.

#### *Regrouping of subsidiaries.*

47. Regrouping of small road transport undertakings following the railway participation had as a result with the *Netherlands Railways* economies of staff, rolling stock, buildings and purchase of materials and fuel.

#### *Expansion of participation.*

48. The favourable experiences the railways had with their participation in road transport undertakings form a stimulus to expand them. For the *Netherlands Railways* the possibility to do so depends on the Government policy. The *Finnish State Railways* intend to obtain all the help needed in handling goods traffic and a sound co-operation in passenger traffic. The *Swedish State Railways* continue to expand with a view to establish a co-ordinated rail and road service.

### PART III.

#### SUMMARY.

##### Participation as a method of operating road vehicles.

49. The operation of road vehicles may be organised in three ways:

direct: the railway uses the road vehicles within its own undertaking;



indirect : the railway makes contracts with professional road carriers to operate transport services with road vehicles;

semi-direct : the railway participates in a new or existing transport undertaking which operates road vehicles.

50. The form of participation in road transport undertakings often has many attractive properties for technical operation, commercial management, wages and labour conditions, investments, goodwill and delegation of responsibility.

With this form the subsidiary company may be given the same status as those of the other road transport companies with which it has to compete. In other words : a railway owned road transport company has the same character, works under the same conditions, is submitted to the same laws, can speak the same language and can act in the same way as any other road transport company competing in the transport market for the favours of consignors and passengers. Moreover in countries, where a licence system for road transport exists, participation in existing enterprises is often the only possibility for the railways to obtain a road transport system.

#### Liberty of participation.

51. It appears that, where the railways, with the exception of a few, have been nationalized and consequently have lost their independence, and form a part of a general transport organisation, they are in general not entitled to operate road vehicles. A fortiori they lack the authority to participate in road transport undertakings.

52. Where the railways have kept their independence, they have in general the authority to adopt road vehicles. All three forms of organisation are used by them. The method of direct operation is generally used in freight traffic, and to a lesser extent in passenger traffic. The contract method in freight traffic occurs rather often and in passenger traffic to a less degree. Many

undertakings are allowed to apply the method of semi-direct operation. It is used by *American Railroads*, the *Finnish State Railways*, the *Indian Railway Board*, the *Netherlands Railways*, the *Norwegian State Railways* and the *Swedish State Railways*.

53. The authority to operate road vehicles is usually connected with the possession of a licence, issued by the normal licensing authority. Moreover in various countries it is necessary to have a special approval from the Government for participation in road transport companies; the issue of such a licence depends on the general transport policy.

Most railway undertakings are of the opinion that their nationalised status has not promoted their participation in road transport companies. The participation policy of some of them has been promoted by the co-ordination policy of the Government.

54. It appears that the railways in general, with regard to adopting a new technique have not the liberty of other undertakings which are obliged and also allowed to follow the development of technical possibilities and the requirements of their customers.

#### Actual participation.

55. The reasons for non-participation appear for the greater part to be due to the slight amount of competition road transport causes the railways, amongst other things due to the degree of protection the co-ordination policy of the government offers the railways.

56. It appeared that the motives for adopting road vehicles in general and for participation in road transport in particular are the competition with road transport and the desire to rationalize the railway undertaking, to improve the quality of the transport services and to enlarge their variety. These aims have not yet

been reached entirely. The method of semi-direct operation appeared to be as effective as that of direct operation.

57. For the operation of road vehicles the railways have participated in newly established road transport undertakings as well as in existing companies. A special preference for either method is not shown.

58. The activities of the road transport undertakings in which the railways have participated appear to be manifold. An ample use has been made of the bus for the operation of services parallel to the railways. To a smaller extent individual trains have been substituted by bus services and to a very small extent the complete passenger train service has been replaced.

In freight traffic, trucks are mainly used by the subsidiaries for collection and delivery services. The transport of full load traffic also occurs. The truck is generally used to replace a railway closed to traffic, but not to a large extent.

The affiliated road transport undertakings do not appear to be the only method of organisation applied for the operation of road vehicles for the same tasks. Beside the method of semi-direct operating other methods of operation are usually applied.

59. The networks, operated by bus companies, in which railways have participated, in some cases appear to be much larger than the railway network open to passenger traffic. The number of passengers transported by road is usually smaller than by rail; likewise the average distance travelled by passengers. In the total bus transport of their country the railway bus services occupy an important place.

60. The weight transported by the semi-direct operated railway truck services forms only a small part of the railway goods transport and of the total road transport. The proceeds, however, are more significant.

61. The indirect operation of road

vehicles by contract appears to be not expedient to control the contracting road transport undertaking or to participate in its management. The railways appear to exert their influence on the road transport undertakings in which they have participated by appointing members of the Board of Management or the Board of Directors. This authority is mainly due to their shareholdings.

62. Special organisations for the internal co-operation of railways and affiliated road transport undertakings only exist with the *Netherlands Railways* and the *Norwegian State Railways*. Special co-operating organisations for the rationalisation of the various affiliated companies only exist with the *Netherlands Railways*. With respect to the size of the undertaking in which it is participated there does not seem to be a special preference.

63. The investments of the railways in the road transport undertakings only amount to a small part of the investments in the railways themselves. The dividend paid forms a modest contribution to the revenue of the railway undertaking.

The receipts of the railways are also indirectly influenced as a rational division of tasks has been obtained between rail and road.

64. The participation of railways in road transport undertakings has, in general, also yielded economic benefits. It has improved the public transport services by rail and road, and it has also promoted the co-ordination between the various means of transport.

65. For the railways themselves participation has strengthened their position in the competition between transport undertakings. It has achieved an important rationalisation. These favourable experiences are for all railways, which have participated in road transport undertakings, a stimulus to expand their participation in other undertakings.

### Recommendations.

66. On account of the favourable experiences obtained with participation in road transport undertakings by the semi-direct method of operating road vehicles it is to be recommended that the administrations give full attention to the possibilities of its application, i.e. to expand to general transporters.

67. The railways should be free to participate in road transport undertakings in order to rationalize their existing production process, to improve the quality of their transport services and to expand their variety. In this way the costs of production of the railways are reduced, the needs of consignors and of passengers better served and social losses prevented by a smooth development of the technique.

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## INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

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16th. SESSION (LONDON, 1954).

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### QUESTION 7.

**Modernisation of the methods to be adopted for recruiting the staff in number and qualification.**

**Harmonious renewal of the various ranks, indispensable reserve lists, ratio of the permanent and temporary staff.**

**Part played by the medical service in the recruiting.**

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### REPORT

*(Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia),*

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#### I. GENERAL CONSIDERATIONS.

The questionnaire on which this report is based was drawn up in collaboration with Mr. F. LEMASS, General Manager, Coras Iompair Eireann, Ireland, and was sent to 67 Administrations.

Amongst these, 25 supplied useful information, 10 excused themselves as not being in a position to do so, whilst 32 did not reply.

To those Administrations who sent in detailed replies, and also to those who, for diverse reasons, were not able to answer all the questions (and they were very nu-

merous) but who nevertheless did their best to reply as fully as possible, the Reporters wish to tender their thanks for the care taken in replying and the trouble they took to give precise and complete data whenever possible.

The questionnaire sent to the Administrations was divided into 6 groups, with a total of 50 questions, as reproduced below, before each of the replies.

The object of the enquiry was to collect information on the following points :

— Present labour position;

Distribution of the staff as regards quality

and numbers. Conditions imposed when recruiting staff for each of the categories concerned or when passing from one category to another;

— Age limits. Reasons why members of the staff leave, and their relative importance. Medical inspection on engagement or during service. Importance of medical advice regarding decisions made;

— Average age of the staff per category and number of employees of each age group. Annual requirements of new labour;

— Fluctuations in the number of staff during recent years. Causes thereof, known or presumed;

— Difficulties encountered in maintaining the labour force both as regards numbers and quality, and how this is linked up with the recruiting policy (or absence of such a policy) followed to date;

— Proposed modifications to the regulations and suggestions for an ideal formula.

\* \* \*

*Remarks.* — Owing to the different forms of organisation, structure and classification adopted by the Administrations consulted, the work of analysing the replies received must be taken with some reservations.

For example in the statistics prepared from the data supplied by the different railways, there is no need to dwell upon certain divergencies or disparities due either to the overlapping of the different grades, or to different classification methods, or again different ideas regarding the meaning of the words or terms employed.

The Reporters wish to thank MESSRS CHARLET and DANCOT, officials of the S.N.C.B., who were good enough to make themselves responsible for collecting, analysing and grouping the information received. This preparatory work, which was a very arduous and difficult job, was carried through to the complete satisfaction of the Reporters whose task was considerably facilitated thereby.

On the other hand, it must not be forgotten that many of the details relative to the organisation, structure and methods could not be included as, although of interest to many undertakings, to analyse them would have unduly lengthened the report with a risk of making it confused and difficult to understand.

And finally, it must not be forgotten that to a certain extent the replies received, generally as rich in substance as clear in their presentation, reflect the constraint due to regulations which have to be adapted to the legislation of the country concerned, so that there appear to be anomalies where there are none since they explain themselves when it is remembered how legislation influences all public utility undertakings.

We wish to thank the railways who, in order to make things quite clear, appended to their replies a voluminous documentation regarding the regulations; we have tried to disengage the essential principles thereof.

## II. REPLIES OF THE RAILWAY ADMINISTRATIONS TO THE QUESTIONNAIRE.

### GROUP 1.

#### Establishment (Number of personnel).

#### QUESTION I.

*What is the size of your establishment (number of personnel) and how is it made up :*

a) according to function :

*unskilled workmen;*

*skilled workmen;*

*supervisory staff;*

*clerical staff;*

*officials;*

*technicians (engineers, architects, etc.) ?*





labourers, 1 to 35 for supervisory staff, and 6.5 to 63.5 for clerical staff, 0.5 to 2.5 for officials and 0.25 to 1.75 for technicians).

On the other hand, the permanent staff usually varies within narrower limits (between 75 and 99 % of the establishment) except on the Gafsa Railway (64.5 %), French West African Railways (33 %), Madagascar Railways (23.5 %), Indo-China (24 %) and Cambodia (19.65 %).

It will be noted that a high proportion of temporary or auxiliary staff is a feature of the colonial railways.

## QUESTION 2.

- a) *By what standards do you base your requirements for personnel?*
- b) *How do you watch and control the numbers required in each of your main departments?*
- c) *In the last 25 years, have your tests for deciding requirements altered? Why and in what way?*

## REPLIES.

The information supplied which is summed up in Tables 2, 3 and 4 show that the

TABLE 2. — Criteria on which the labour requirements are based.

RAILWAYS	Volume and kind of work	Operating estimates and volume of traffic	Estimates maintenance works	Changes in establishment and labour forces	Mechanisation	Rationalisation	Working conditions tools	Rests, illnesses, holidays.	On request from operating departments (service necessities)
<i>Deutsche Bundesbahn</i>	×	...	...	...	...	...	...	...	...
<i>Austrian Rys.</i> .....	...	×	×	...	...	...	...	...	...
<i>S.N.C.B.</i> .....	×	...	...	×	...	...	...	×	...
<i>S.N.C.V.</i> .....	...	×	...	...	...	...	...	...	...
<i>Otraco.</i> .....	...	×	...	...	×	×	...	...	...
<i>R.E.N.F.E.</i> .....	×	×	...	...	...	...	...	...	...
<i>S.N.C.F.</i> .....	×	...	...	...	×	...	×	...	...
<i>R.A.T.P.</i> .....	...	×	...	×	...	...	×	...	×
<i>Algerian Rys.</i> .....	...	...	...	...	...	×	...	...	×
<i>Gafsa Ry.</i> .....	...	...	...	...	...	...	...	...	×
<i>Tunisian Rys.</i> .....	...	×	...	...	...	...	...	...	...
<i>West African Rys.</i> ..	...	×	×	×	×	...	...	...	...
<i>Madagascar Rys</i> ..	...	...	...	×	...	...	...	...	...
<i>Indochina Rys.</i> .....	...	×	...	...	...	...	...	...	...
<i>Cambodian Rys.</i> ....	×	...	...	...	...	...	×	×	...
<i>Italian Rys.</i> .....	...	...	...	...	...	...	...	...	×
<i>North of Milan Ry.</i> ..	...	...	...	...	...	...	...	...	×
<i>Luxemburg Rys.</i> .....	...	...	×	×	...	...	...	...	...
<i>Netherlands Rys.</i> .....	...	...	...	×	...	...	...	...	×
<i>Portuguese Rys.</i> .....	...	...	×	×	...	×	...	...	...
<i>Swiss Federal Rys.</i> .....	...	×	×	...	...	...	...	...	...
<i>Rhaetian Ry.</i> .....	...	...	...	...	...	...	...	...	×
<i>Damas Ry.</i> .....	...	...	...	...	...	...	...	...	...
<i>Syrian Rys.</i> .....	...	×	...	×	...	...	...	...	...
<i>Turkish Rys.</i> .....	×	×	×	×	...	...	...	...	...

TABLE 3. — Supervision and control of labour.

RAILWAYS	Supervision			Level standard		Kind of control			
	Weekly	Monthly	Yearly	District	Central	On site	File index or table	Multi-copying form	Comparison with the traffic
<i>Deutsche Bundesbahn</i>	...	×	...	...	×	...	×	...	...
<i>Austrian Rys.</i>	...	×	...	...	×	...	...	...	...
<i>S.N.C.B.</i>	...	×	...	×	×	×	×	×	...
<i>S.N.C.V.</i>	...	×	...	...	...	...	...	...	...
<i>Otraco</i>	...	...	...	...	...	...	...	...	×
<i>R.E.N.F.E.</i>	...	×	...	...	...	...	...	...	...
<i>S.N.C.F.</i>	daily	...	...	×	×	×	×	...	...
<i>R.A.T.P.</i>	daily	...	...	...	×	...	×	...	...
<i>Algerian Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Gafsa Ry.</i>	...	...	...	...	×	...	...	...	×
<i>Tunisian Rys.</i>	...	...	×	×	×	...	...	...	×
<i>West African Rys</i>	...	...	...	...	×	...	×	...	...
<i>Madagascar Rys</i>	...	...	...	...	×	...	×	...	...
<i>Indochina Rys.</i>	...	...	...	...	×	...	×	...	...
<i>Cambodian Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Italian Rys.</i>	...	×	×	...	×	...	×	...	...
<i>North of Milan Ry</i>	...	×	...	...	×	...	×	...	...
<i>Luxemburg Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Netherlands Rys.</i>	×	×	...	...	×	...	...	×	...
<i>Portuguese Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Swiss Federal Rys.</i>	...	...	...	×	...	×	...	...	...
<i>Rhaetian Ry.</i>	...	...	...	...	×	...	×	...	...
<i>Damas Ry.</i>	...	...	...	...	...	...	...	...	...
<i>Syrian Rys.</i>	...	×	...	×	×	...	×	...	...
<i>Turkish Rys.</i>	...	×	...	...	×	×	×	...	...

criteria, on which the labour requirements of the different railways are based, vary considerably from one railway to another.

It should be noted however that the operating estimates of the volume of traffic is the most frequently adopted criterium.

As regards supervision and control of labour, in the great majority of cases, this is centralised, carried out monthly and obtained from file index records or tables.

Finally, these criteria vary on most railways in terms of modifications in working hours, political and social conditions and new working conditions due to rationalisation.

### QUESTION 3.

*Do you apply the same tests to evaluate your requirements for permanent staff and for temporary staff?*

### REPLIES.

An affirmative reply was given by the Deutsche Bundesbahn, Austrian Federal Railways, S.N.C.B., Otraco, R.E.N.F.E. (where it is forbidden to increase the staff during the year), Gafsa, Madagascar, Italian, North of Milan, Swiss Federal, Rhaetian and Turkish Railways.

TABLE 4. — Fluctuations during the last 25 years of the criteria on which the labour requirements are based.

RAILWAYS	Yes	No	8 hours' day holidays	Political and social conditions	Economic conditions	Rationalisation (working conditions)	Traffic evolution
<i>Deutsche Bundesbahn</i>	×	...	×	...	...	...	...
<i>Austrian Rys.</i> .....	×	...	...	×	×	...	...
<i>S.N.C.B.</i> .....	×	...	...	...	...	×	...
<i>S.N.C.V.</i> .....	...	×	...	...	...	...	...
<i>Otraco.</i> .....	×	...	...	...	...	...	×
<i>R.E.N.F.E.</i> .....	...	×	...	...	...	...	...
<i>S.N.C.F.</i> .....	×	...	...	...	...	×	...
<i>R.A.T.P.</i> .....	×	...	...	...	...	×	...
<i>Algerian Rys.</i> .....	×	...	...	...	...	×	...
<i>Gafsa Ry.</i> .....	×	...	×	×	...	...	...
<i>Tunisian Rys.</i> .....	...	×	...	...	...	...	...
<i>West African Rys.</i> ...	×	...	...	...	...	×	...
<i>Madagascar Rys.</i> ...	...	×	...	...	...	...	...
<i>Indochina Rys.</i> .....	×	...	...	×	...	...	...
<i>Cambodian Rys.</i> ...	...	×	...	...	...	...	...
<i>Italian Rys.</i> .....	...	×	...	...	...	...	...
<i>North of Milan Ry.</i> ..	×	...	...	×	...	...	...
<i>Luxemburg Rys.</i> .....	...	...	...	...	...	...	...
<i>Netherlands Rys.</i> .....	×	...	×	×	...	×	...
<i>Portuguese Rys.</i> .....	×	...	...	...	...	×	...
<i>Swiss Federal Rys.</i> ..	×	...	...	...	×	...	...
<i>Rhaetian Ry</i> .....	...	×	...	...	...	...	...
<i>Damas Ry.</i> .....	...	...	...	...	...	...	...
<i>Syrian Rys</i> .....	...	...	...	...	...	...	...
<i>Turkish Rys.</i> .....	...	×	...	...	...	...	...

A negative reply was given by the S.N.C.V. (Belgium), S.N.C.F., R.A.T.P., Algerian, Tunisian, West African, Viet Nam, Cambodian, Portuguese and Syrian Railways.

All the railways with different criteria for ascertaining their temporary labour requirements take into account seasonal and accidental work.

The Luxembourg National Railways Company, only recently constituted, has not yet made any agreements in this connection with staff representatives.

The S.N.C.F. is authorised to make use of auxiliary staff up to 10 to 15 % of the total labour (7 % at the present time). They are used for jobs reserved to begin-

ners, with no responsibility regarding safety, within the authorised grades, and for seasonal labour increases. Such auxiliary staff, rapidly initiated, is admitted to the permanent staff as soon as circumstances warrant.

On the R.A.T.P. temporary staff are only engaged for a limited period : exceptional work or replacements during the annual holidays.

#### QUESTION 4.

*What operating considerations or other factors give rise to the employment of temporary staff, and has such temporary employment any advantage other than that arising from economic working?*



*Is there a ratio of temporary to permanent staff and, if so, how is this determined? Do the numbers given represent this ratio?*

### REPLIES.

The table below shows that all the railways, except the Italian Railways where the recruiting of temporary staff is no longer allowed, make use of such staff to deal with seasonal work and to obtain more economical working.

About half the railways also use temporary staff for new constructions or unexpected work.

The proportion of such temporary staff varies on most railways, but is fixed on the S.N.C.F. (10 to 15 %), on the Tunisian Railways (55 % maximum), Madagascar Railways (25 to 50 %) and Indochina (not more than 50 %).

### QUESTION 5.

*Have you observed any difficulties due to recruiting too many temporary staff from the social point of view (numerous and frequent dismissals) the effect on workmanship and the difficulty in coping with sudden demands, etc.?*

TABLE 5. — Utilisation of temporary staff.

RAILWAYS	Utilisation				Advantages		Proportion	
	Seasonal work	New constructions	Unexpected work	Economic considerations	Economic working	Other advantages	Fixed	Variable
<i>Deutsche Bundesbahn</i>	×	×	...	...	×	...	...	×
<i>Austrian Rys.</i> .....	×	...	...	...	×	...	...	×
<i>S.N.C.B.</i> .....	×	×	×	...	×	...	...	×
<i>S.N.C.V.</i> .....	×	×	...	...	×	...	...	×
<i>Otraco</i> ... ..	×	...	...	...	...	...	...	×
<i>R.E.N.F.E.</i> .....	...	...	×	...	×	...	...	...
<i>S.N.C.F.</i> .....	×	×	×	...	×	...	10 to 15%	...
<i>R.A.T.P.</i> .....	×	...	...	...	×	...	...	×
<i>Algerian Rys.</i> .....	×	×	×	...	×	...	...	×
<i>Gafsa Ry.</i> .....	×	...	...	...	×	...	...	×
<i>Tunisian Rys.</i> .....	×	...	...	...	×	...	55% maximum	...
<i>West African Rys.</i> ..	×	...	...	...	×	...	...	×
<i>Madagascar Rys.</i> ...	×	...	...	...	×	...	50% to 25%	...
<i>Indochina Rys.</i> .....	×	...	×	...	×	...	50% maximum	...
<i>Cambodian Rys.</i> ....	×	×	×	...	×	...	...	×
<i>Italian Rys.</i> .....	Recruiting of temporary staff no longer allowed						...	...
<i>North of Milan Ry.</i> ..	×	...	...	...	×	...	...	×
<i>Luxemburg Rys.</i> .....	×	...	...	...	×	...	...	×
<i>Netherlands Rys.</i> ....	×	...	×	...	×	...	...	×
<i>Portuguese Rys.</i> .....	×	×	×	...	×	...	...	×
<i>Swiss Federal Rys.</i> ..	×	×	×	...	×	...	...	×
<i>Rhaetian Ry</i> .....	×	×	×	...	×	...	...	×
<i>Damas Ry.</i> .....	...	...	...	...	...	...	...	...
<i>Syrian Rys</i> .....	×	...	...	...	×	...	...	×
<i>Turkish Rys.</i> .....	×	×	×	...	×	...	...	×

## REPLIES.

All the railways replied in the negative except :

- a) S.N.C.F. : no major drawbacks, but difficulties in obtaining temporary labour owing to the housing shortage and limited benefits given to temporary staff;
- b) Gafsa Railways : no major inconvenience; they consider this method has a bearing on the social factor;
- c) Tunisian Railways : are criticised by the trade unions from the social point of view;
- d) Portuguese Railways : report social disadvantages (repeatedly out of work) and economic drawbacks (staff generally of poorer quality). They also report difficulties in meeting unexpected labour demands;
- e) Swiss Federal Railways : labour of inferior quality, and often kept on longer than is necessary in periods of unemployment.

## QUESTION 6.

*Are you obliged legally to give any priority in recruiting to war or civil invalids?*

## REPLIES.

The replies were in the negative except in the case of :

The Deutsche Bundesbahn : a percentage of available jobs is reserved for handicapped men;

The Austrian Federal Railways;

The S.N.C.B.;

The S.N.C.V. : priority given to disabled men in the case of half the jobs with wages less than 30 000 fr.;

The R.E.N.F.E. : preference given by law to ex-service men, ex-prisoners-of-war or relations of men killed in the war; is no longer serious owing to the time that has elapsed since hostilities. On the other

hand, every year priority is given to 400 soldiers from the railway forces who have received special training;

The S.N.C.F. : priority up to a certain proportion to those disabled during the war, whether soldiers or civilians, war widows who have not remarried, and ex-servicemen;

R.A.T.P. : in the proportion laid down by law.

The Algerian Railways : up to 1931 certain jobs were reserved for natives — a return to these measures is under consideration;

Madagascar Railways : with the reserve that those having priority have the necessary professional skill;

Viet-Nam Railways;

Italian Railways : office jobs which are competed for; 10 % of the jobs are reserved for disabled ex-servicemen and 5 % for disabled civilians; junior office jobs, without competition : 10 % reserved for disabled ex-servicemen and 5 % for disabled civilians; labourers jobs : 6 to 10 % for disabled ex-servicemen and 3 to 5 % for disabled civilians

North of Milan Railway;

Turkish Railways.

## GROUP 2.

Recruiting labourers and office personnel.

## QUESTION 1.

*From what sources is staff recruited :*

- a) *unsought applications?*
- b) *replies to advertisements?*
- c) *State or other employment agencies?*
- d) *schools, technical colleges, universities?*
- e) *recommendations?*
- f) *other sources than above? (Please specify)*

## REPLIES.

With the exception of the Italian and Luxemburg Railways, all railways are ready to consider applications for employment; about half of them advertise vacancies in the press or on the radio; a few make use of labour offices run by the Government or private employment agencies.

Nearly all get their staff from the schools, technical training centres and universities. It is surprising to learn that a few railways accept recommendations.

It can be said that in practice the railways do not make use of other sources for recruiting labour.

The various information received is summed up in table form below.

TABLE 6. — Sources from which labour is recruited.

RAILWAYS	Requests for employment	Answers to advertisements	State run labour offices or employment agencies	Schools, technical training centres, universities	Recommendations	Other sources than those listed previously
<i>Deutsche Bundesbahn</i>	Yes	No	Yes	No	No	Trainee students
<i>Austrian Rys.</i> .....	Yes	No	seldom	seldom	No	No
<i>S.N.C.B.</i> .....	Yes	Yes	No	Yes	No	Labour exchanges
<i>S.N.C.V.</i> .....	Yes	No	No	No	No	unemployment centres
<i>Otraco.</i> .....	Yes	Yes	No	Yes	Yes	No
<i>R.E.N.F.E.</i> .....	Yes	Yes	Yes	No	No	No
<i>S.N.C.F.</i> .....	Yes	sometimes	No	No	No	No
<i>R.A.T.P.</i> .....	Yes	exception.	exceptional	No	Yes	No
<i>Algerian Rys.</i> .....	Yes	seldom	No	Yes	No	No
<i>Gafsa Ry.</i> .....	Yes	No	No	Yes	No	No
<i>Tunisian Rys.</i> .....	Yes	No	exceptional	Yes	No	Employment offices
			S.N.C.F.			
<i>West African Rys.</i> ..	Yes	Yes	No	Yes	No	No
<i>Madagascar Rys.</i> ..	Yes	seldom	very seldom	Yes	No	No
<i>Indochina Rys.</i> .....	Yes	Yes	Yes	Yes	No	No
<i>Cambodian Rys.</i> .....	Yes	Yes	No	Yes	No	Apprentice schools and S.N.C.F.
<i>Italian Rys.</i> .....	No	Yes	Yes	No	No	No
<i>North of Milan Ry.</i> ..	Yes	sometimes	No	No	No	No
<i>Luxemburg Rys.</i> .....	No	Yes	No	No	No	No
<i>Netherlands Rys.</i> .....	Yes	Yes	Yes	Yes	No	Professional advice bureaux
<i>Portuguese Rys.</i> .....	Yes	No	No	Yes	Yes	No
<i>Swiss Federal Rys.</i> ..	Yes	Yes	No	Yes	No	No
<i>Rhaetian Ry.</i> .....	Yes	Yes	No	Yes	Yes	No
<i>Damas Ry.</i> .....	Yes	No	No	Yes	Yes	No
<i>Syrian Rys.</i> .....	Yes	Yes	No	No	No	No
<i>Turkish Rys.</i> .....	Yes	Yes	Yes	Yes	Yes	Other official establishments



## QUESTION 2.

*Is there within the organisation a systematic plan of recruitment? If so, does this include :*

- a) *timely forecast of vacancies?*
- b) *Completion of a comprehensive application form by the candidate to ascertain if he meets the necessary physical and other requirements, e.g. age, height, education, past experience, nationality, etc.? (Please attach copy of application form or forms in use.)*
- c) *the submission of a diploma or certificate or setting of examination for which a stated standard of education laid down? (Please indicate standards required.)*
- d) *a check with Police Department regarding social background?*
- e) *a job specification giving the description of the job and the qualities required of the candidate to do the job properly?*
- f) *a screening interview to determine the qualities and aptitudes of the applicant? By whom is the interview conducted? Please give details.*
- g) *psychological tests : if psychological tests are applied, please say by whom, i.e. specially trained personnel or outside industrial psychologists? What success has attended their use?*

## REPLIES.

## 1. Western Germany.

*Deutsche Bundesbahn.*

- a) There is a recruiting plan with a list of expected vacancies for certain categories.
- b), c) Yes.
- d) A testimonial as to character is required.
- e) No answer.
- f) Yes for certain higher categories.
- g) Yes for certain categories (responsible

for safety) , given by railway employees. The method has proved satisfactory.

## 2. Austria.

*Federal Railways.*

There is no systematic recruiting plan except for candidates for the higher jobs.

- a) Yes.
- b) No; such information has to be supplied by the candidates.
- c) Diplomas or study certificates have to be produced. No examinations.
- d) Yes; the police are consulted.
- e), f) No.
- g) Yes, for jobs concerned with the safety — carried out by railway employees. The method has proved satisfactory.

## 3. Belgium and Colony.

a) *Belgian National Railways.*

There is no systematic recruiting programme.

- a) No.
- b) Yes.
- c) All employees and certain categories of labourers (electricians, signalmen, locomotive firemen) are recruited on the results of a competitive examination. *Labourers* : an examination on the level of the primary school or secondary technical instruction.

*Lower grades* : on the level of the lower intermediate instruction.

*Higher grades* : (clerks, accountants) level of higher intermediate grade with diploma for lower intermediate grade.

- d) Testimonial as to character and a clear record.
- e), f) No.
- g) A psychotechnical examination is made by specialists of the medical centres; this is obligatory for locomotive firemen and signalmen. The method has proved satisfactory.

b) *National Light Railways.*

At the present time, there is no systematic recruiting programme.

- a) Requests for employment form a reserve for the recruiting of labour.
- b) Yes; biographical records for candidates taken into employment.
- c) For certain categories of labourers : diploma of the professional schools.  
For lower grades : lower intermediate education certificate.  
For employees of the higher grades : upper intermediate.
- d) Testimonial as to character.
- e) No, except for collectors and motormen.
- f) No.
- g) Psychotechnical examination for collectors and motormen carried out by a psychotechnician attached to the S.N. C.V. The results have been satisfactory.

c) *Otraco.*

There is a systematic recruiting programme.

- a), b), c), d), e) Yes.
- f) Yes; carried out by specialist staff in the presence of the candidates.
- g) Yes; carried out by an outside psychotechnician. This has proved satisfactory.

## 4. Spain.

*Red Nacional  
de los Ferrocarriles Españoles.*

- a), b) Yes.
- c) Certain jobs are allocated on the results of a competitive examination in connection with the duties involved. In certain cases a diploma is required, without any competitive examination.
- d) Testimonial as to character.
- e), f), g) No.

## 5. France and French Union.

a) *French National Railways.*

- a) The labour requirements are decided at the end of each year for each department according to the amount of traffic expected. Any factor which does not come into these forecasts involves an alteration to the programme during the year.
- b) Yes.
- c) For all preliminary employment : a competitive examination.  
*Examinations : Labourers :* writing, spelling, arithmetic, and if needs be a professional test.  
*Gangers and platelayers :* as above without professional test.  
*Clerks :* level of primary education certificate.  
*Competitive examination : Office staff :* level of the elementary education certificate.
- d) Extract from judicial files.
- e) The conditions to be fulfilled to pass certain examinations or competitive examinations are published.
- f) No.
- g) Yes, before employment in certain preliminary grades. The psychotechnical examination is given in a special laboratory of the Company.

b) *R.A.T.P.*

- a) Daily check of labour requirements and provision for an increase.
- b) Yes.
- c) For *executives* : no diploma but an examination on the level of primary education; in addition, a professional test for labourers.  
For *office staff* : Baccalaureat or higher certificate; in addition selective test.
- d) Extract from the judicial files and enquiry from the police services.

- e) A regulation lays down the conditions of physical fitness and general knowledge required.
- f) All employees have to pass an admission test organised by the recruiting office at primary education level : dictation, spelling, 4 arithmetical rules and a simple problem. The holding of certain diplomas exempts from this test.
- g) Yes; an examination carried out in the special laboratories of the company by qualified psychotechnicians. Completely satisfactory.

c) *Algerian Railways.*

There is no systematic recruiting programme.

- a) A table is prepared every year showing the labour position by job and by grade.
- b) Yes. Every candidate for a permanent job has to undergo a medical, T.B. and ophthalmological examination.

- c) *Unskilled labourers* : examination on the level of the general education certificate.

*Skilled labourers* : examination on a higher level.

*Clerical staff* : examination on the level of the elementary certificate.

*Technicians* : the necessary diploma.

- d) An extract from the judicial files going back at least 3 months is required.
- e) Jobs are classified according to the special physical aptitude required in each case.
- f) The programme makes no provision for selection interviews. Candidates state the job they are applying for.

Labourers have to undergo a professional test in the presence of staff delegates.

- g) Apprentices undergo psychotechnical examinations according to the jobs they are likely to have in the future, as do the qualified staff of the system. This method has proved satisfactory.

d) *Gafsa Railway.*

There is a systematic programme for recruiting labour for certain jobs.

- a), b) Yes.

- c) *For labourers* : certificate of professional skill or a professional test.

*For consigning clerks and clerical staff* : elementary certificate or an examination below the standard of the elementary certificate.

- d) Production of an extract from the judicial files.

- e) No.

- f) Only in the case of staff on probation. The interrogation takes the form of a talk with the head of the department.

- g) No.

e) *Tunisian Railways.*

There is no recruiting plan except in the case of permanent staff.

- a) Recruiting takes place according to labour requirements.

- b) Yes.

- c) Diploma required in the case of permanent staff. The level of education required is the same as on the S.N.C.F.

Labourers : professional test before being engaged.

- d) No check with the police but production of an extract from the judicial files and testimonial as to character.

- e) f) No reply.

- g) No psychotechnical examinations are held.

f) *French West African Railways.*

- a) An annual recruiting programme is drawn up for each of the four regions of the system. This programme takes into account all vacancies due to staff changes.

- b) There are no forms to fill in; the age limits are 18 to 30 years. Candidates



must be French by birth or naturalised for 5 years.

A thorough medical examination has to be passed.

- c) Executive jobs are reserved for Africans. Such employees are recruited as required or through competitive examinations.
- d) Extract from the judicial files; military service obligations are also taken into account.

e), f) No reply.

- g) No psychotechnical examinations are held.

#### g) *Madagascar Railways.*

There is no systematic programme. The railway lays down recruiting conditions by statute.

- a) No, not as a general rule.
- b) There are no forms to fill in; the candidate has to have a diploma or pass either a professional or general education examination. In addition, he has to produce a medical certificate and prove that he has no contagious illness.
- c) Must have been a citizen of one of the States or Territories of the French Union for at least 5 years.
- d) Yes.
- e) No.
- f) The candidate has to have a diploma, or in default, undergo a professional or general education examination.
- g) No.

#### h) *Viet-Nam Railways.*

There is no systematic recruiting programme.

- a), b) Yes.
- c) Yes; must have a diploma or undergo an examination.
- d) Yes; checked with the police.
- e) There is a monograph for each job.
- f) No.

- g) The railway has no psychotechnical service.

#### i) *Cambodian Railways.*

Have a systematic recruiting programme.

- a), b), c), d), e) Yes.
- f), g) No.

### 6. Italy.

#### a) *State Railways.*

There is a systematic recruiting programme.

- a) Each year the expected vacancies due to promotion, death or retirement are forecast.
- b) Yes.
- c) In the case of jobs that have to be competed for, the candidate has to produce the necessary diploma. This also applies to the admission without competitive examination of candidates from the railway regiment and non-commissioned officers.
- d) In the case of civilian candidates and soldiers from the railway regiment, a check of their moral and civic character. This does not apply to non-commissioned officers, as only those whose character is beyond reproach are allowed to transfer to the railway.
- e) There are official notices giving the conditions to be fulfilled.
- f) In addition to the public competitive examinations, there are examinations in general and specialised knowledge.
- g) Yes; the psychotechnical examinations are carried out by the staff of the Administration; the first trials were made in 1952, so that it is premature to state if the results are satisfactory.

#### b) *North of Milan Railway.*

There is no recruiting programme.

### 7. Luxembourg.

*Luxembourg National Railways Company.*

There is a systematic recruiting programme.

a), b) Yes.

c) Artisans have to provide a certificate at the end of their apprenticeship.

Clerical staff : a diploma that they have completed their intermediate studies.

d) Extract from the judicial files which is checked.

e) No.

f) In principle : examination or competitive examination for admission except for artisans. Traction staff : psychotechnical examination.

g) Yes.

*Professor of criminology* : for locomotive staff.

*Private industrial psychotechnician* for staff driving cars, lorries and buses.

### 8. Netherlands.

*Netherlands Railways.*

There is a systematic recruiting programme based on the vacancies expected.

a), b), c) Yes.

d) Yes by the railway police.

e) No.

f) The candidate is interviewed by the head of the department concerned in order to ascertain his character and provide him with information about the vacancies available.

g) Psychotechnical examinations are organised by specialist staff and have proved satisfactory.

### 9. Portugal.

*Portuguese Railways Company.*

The conditions of admission are laid down in the regulations according to the category of staff.

a), b) Yes.

c) A certificate of education or an examination or both are required.

*Unskilled labourers* : primary elementary education.

*Skilled labourers* : pupils from the school of apprentices. Priority is given to those holding certificates from the professional industrial schools.

*Station and train staff* : primary elementary education; written and oral examination followed by a 6 months trial after which an examination must be passed.

*Locomotive staff* : primary elementary education; written and oral examination; 3 or 6 months trial at the end of which an examination must be passed.

*Office staff* : minimum level required : first collegiate grade and in addition a written and oral competitive examination.

d) Yes.

e), f), g) No.

### 10. Switzerland.

a) *Swiss Federal Railways.*

Recruiting depends on the number of employees leaving and the need to fill vacancies.

a), b), c) Yes.

d) Extract from the judicial files and testimonial as to character.

e) Nothing.

f) Yes; an interview with a higher official, or the head of the department in order to ascertain the attitude, behaviour and linguistic knowledge of the candidate.

g) Psychotechnical examinations are held in the case of candidates for certain qualified jobs or when the selection of a suitable candidate is difficult, when the job requires special aptitude, and for shop apprentices and candidates for the locomotive department. The psycho-

technical service is run by specialists and the methods employed has proved satisfactory.

b) *Rhaetian Railway.*

There is a systematic recruiting programme.

- a) Yes; probable vacancies are taken into account.
- b) Yes.
- c) Certificates are required. The required level : higher primary education at least.
- d) Checked with responsible citizens.
- e) Yes.
- f) An examination is held in the case of candidates for the station, train and permanent way maintenance staff in order to determine their aptitude, degree of knowledge and intelligence.
- g) No.

## 11. Syria.

a) *Damas-Hamah Railway.*

No systematic recruiting.

b) *Syrian State Railways.*

Recruiting takes place as necessary.

## 12. Turkey.

*Turkish Railways.*

The permanent and temporary staff is fixed in the budget.

The general lists are based on the typical list for each department separately and each regional and central department.

In addition, annual losses are taken into account (deaths, retirements, promotions).

- a) Yes.
- b) Yes; a medical examination only takes place after the candidate has satisfied all administrative requirements.

- c) The production of a diploma or certificate does not dispense candidates from being examined.

The production of such certificates entitles the candidate to monthly allowances as laid down by law, according to his level of education. Each degree of general or professional education corresponds to a given grade on the legal scale.

- d) Yes, and if possible references from two employees of the Administration.
- e) No.
- f) No; this point is now being studied.
- g) Yes; a psychotechnical examination is held by the psychiatrist of the Administration's medical service. The method proved satisfactory.

## QUESTION 3.

*Is recruitment conducted by each main department of the organisation or through a central labour or personnel office? Please say under either system, what constitutes the recruitment authority and who makes final selection.*

## REPLIES.

The replies are summed up in the table hereafter.

## QUESTION 4.

*Is recruitment continuous or made only at certain intervals?*

## REPLIES.

In general recruiting is continuous, according to requirements.

It is rarely periodical (every 6 months or once a year). This is however the practice on the following railways : Deutsche Bundesbahn, Austrian Federal Railways, R.E.N. F.E., Italian Railways, Netherlands Railways (twice or once a year for staff which has to be trained), Portuguese Railways,



TABLE 7. — Organisation of the recruiting of staff.

RAILWAYS	Recruitment		Constitution of offices	Final decision
	Regional	Central		
<i>Deutsche Bundesbahn</i>	Labourers & lower grades	higher grades & officials	...	Central Administration
<i>Austrian Rys.</i> .....	labourers	clerks & officials	...	» »
<i>S.N.C.B.</i> .....	labourers	technic. staff & officials	Groups, Cal. Adm., Chief clerk or assistant clerical staff	» »
<i>S.N.C.V.</i> .....	×	...	...	» »
<i>Otraco</i> .....	...	×	...	» »
<i>R.E.N.F.E.</i> .....	...	×	...	» »
<i>S.N.C.F.</i> .....	×	...	...	» »
<i>R.A.T.P.</i> .....	...	×	...	» »
<i>Algerian Rys.</i> .....	labourers	technical staff officials	...	» »
<i>Gafsa Ry.</i> .....	...	×	...	» »
<i>Tunisian Rys.</i> .....	labourers	technical staff officials	...	» »
<i>West African Rys.</i> ...	×	...	...	Regional Director
<i>Madagascar Rys.</i> ...	temporary staff	permanent staff	...	Central administration or Regional Head
<i>Indochina Rys.</i> .....	lower grades	technical staff officials	...	Central administration
<i>Cambodian Rys.</i> ....	...	×	Two men	» »
<i>Italian Rys.</i> .....	...	×	...	» »
<i>North of Milan Ry.</i> ..	...	×	...	» »
<i>Luxemburg Rys.</i> ....	Auxiliary staff	technical staff officials	...	» »
<i>Netherlands Rys.</i> ....	×	...	...	Head of department
<i>Portuguese Rys.</i> .....	×	...	...	Each department
<i>Swiss Federal Rys.</i> ..	×	...	...	Central administration or Head of district
<i>Rhaetian Ry.</i> .....	×	...	...	Central administration
<i>Damas Ry.</i> .....	×	...	...	Local direction
<i>Syrian Rys.</i> .....	×	...	...	Central administration
<i>Turkish Rys.</i> .....	...	×	...	Central administration (decentralisation is being considered)

Swiss Federal Railways and Rhaetian Railway.

Many railways have however reported that recruiting has ceased for the time being owing to budgetary difficulties.

#### QUESTION 5.

What are your induction arrangements?  
Do they involve :

- a) pre-appointment training carried out after selection?

- b) *post-appointment training?*
- c) *Does the training course involve :*
  - « *training on the job* » only?
  - *training at school or college run by the undertaking? What is the duration of such course?*
  - *training with other organisations?*
  - *other methods than above? If so, please specify.*
- d) *giving new recruits training on company history, policy, wages, promotion, pensions, medical schemes, and amenities generally?*
- e) *distribution of booklet relating to the above matters or a book of Rules?*

## REPLIES.

### 1. Germany.

#### *Deutsche Bundesbahn.*

- a) No.
- b) Trained after being taken on.
- c) Practical training for labourers. A 2 to 6 weeks course in one of the Administrations schools for employees.
- d), e) Yes.

### 2. Austria.

#### *Austrian Federal Railways.*

- a) No.
- b) Yes.
- c) Training includes theoretical and practical instruction. Theoretical instruction is given in the railway schools, and practical training on the job. The courses vary from 1 to 6 months. There is no training in other establishments.
- d) No.
- e) Yes.

### 3. Belgium and Colony.

- a) *Belgian National Railways Company.*
- a) There is no preliminary training before engagement except for a few exceptional

categories (signalmen, welders, inspectors of rolling stock).

However, those concerned are already employed in some other capacity and do not take up the above mentioned jobs unless they successfully pass the proper tests.

In the case of messengers, the training period is 3 years after which they take an examination in order to qualify as book-keepers or guards.

- b) Training after engagement for certain categories of employees : clerks, accountants, assistant accountants, assistant station-masters, mecanographical operators.

This training takes place during the trial period; it is done by means of correspondence courses given by the professional schools; these courses prepare the candidate for the entry examination at the end of his trial period.

- c) Training includes :
  - Practical instruction solely in the case of a few categories of staff (for example welders).
  - Training in one of the schools managed by the Company in the cases covered under b) above.
  - The period varies according to the case but never exceeds one year.
  - No training in any establishments other than the Company's schools.
  - There is a professional school which will give, those who wish, courses of instruction or correspondence courses.

*Object of these courses :* to increase the professional and general knowledge and prepare for certain examination, especially supervisory staff.

All the immediate heads have to give periodical conferences to their employees, to keep their professional knowledge up to date and to increase it.

- d) No.
- e) Upon engagement each member of the staff has to become acquainted with the

staff statute which codifies the basic regulations relating to grades of pay, promotion, pensions, trade union relations, etc.

b) *National Light Railways Company.*

- a) Training before engagement in the case of ticket collectors and drivers.
- b) Training after engagement for other categories.
- c) Training merely covers practical instruction.
- d), e) No.

c) *Otraco.*

- a) Yes.
- b) Yes, especially in the case of administrative jobs.
- c) — No.  
— No.  
— Nothing.  
— Yes, for certain technicians and workmen.  
— No.
- d) No.
- e) Yes.

#### 4. Spain.

*Red Nacional  
de los Ferrocarriles Españoles.*

- a) Certain schools which train pupils for a career on the railway are subsidised.

The railway regiment supplies staff which has received training in certain railway jobs during their military service. When this is completed, those concerned have to pass a practical test.

- b) In the case of other staff, training after engagement, either by :  
apprenticeship for certain trades;  
practical training;  
finishing courses.
- c) Practical training followed by an examination in some cases for certain pro-

fessions, finishing courses and courses of preparation for the higher grades of job, especially owing to electrification.

Railway schools (school-train).

- d) For certain categories, courses dealing with the rights and duties of the staff, wages, promotion, pensions, etc.
- e) Distribution of instructions relative to the above points.

#### 5. France and French Union.

a) *French National Railways Company.*

- a), b) In principle, immediately put on the job.
- c) Exclusively practical training in the lowest jobs.

A great deal of use is made of training by means of schools and general and professional instruction courses, which enables the staff to qualify for the higher grades of jobs (at the present time 55 % of the officials and technicians were engaged without a diploma).

There is a great variety in such schools and courses : evening classes, correspondence courses, full time schools or boarding schools.

On the average 10 000 employees receive instruction in this way every year.

Their superiors keep a special eye on and advise those who have taken such courses on their return to work.

One school takes some thirty pupils for a year, these being promising employees who were not able to pursue their private studies.

*Object :* to increase their general and professional knowledge.

- d) Yes; these subjects are included in the programme of some of our schools.
- e) Distribution of the regulations covering the employment in question.

The men can always consult their superiors.

Libraries are available for their use.



b) *Paris Transport (R.A.T.P.).*

- a) No.
- b) Yes.
- c) — Practical and theoretical.  
— Yes, in schools known as instruction centres.  
— About 5 days to 3 weeks.  
— No.
- d) No.
- e) Each new employee gets a copy of the staff statutes and pensions scheme.

c) *Algerian Railways.*

After a few months employment as auxiliary, the best of the recruits are taken onto the permanent staff.

- a), b) Training is then completed progressively.
- c) — Merely practical training for most jobs : unskilled staff and labourers.  
— Training at a school for security and traffic jobs.  
— Period varies according to the job in question.  
— Training at other establishment for enginemen.  
— No other methods.
- d) No.
- e) Instructions concerning the administrative position of the staff are regularly brought to their notice.

d) *Gafsa Railway.*

- a) Yes for jobs involving safety and when the kind of work requires it.
- b) Yes in the other cases; example shop labourers.
- c) — Practical training in certain cases.  
— No schools.  
— No definite period fixed a priori.  
— Training in other establishment for certain special jobs.

— Correspondence courses are organised by a professor of the Sfax Technical College.

The railway pays about 70 % of the fees provided the subject is of interest to the railway and the employee has the necessary grounding to profit by it.

- d) No.
- e) Not systematically but sometimes when they are reprinted.

e) *Tunisian Railways.*

- a) For certain staff training follows their selection before their definite engagement.
- b) No answer.
- c) For those taken on, practical training the duration of which varies according to the job.

For jobs involving safety : practical and particular training under control.

- d), e) No reply.

f) *French West African Railways.*

- a) No, except for auxiliary staff whose successful passing of the entry examination only establish their qualification.
- b) Evening classes.

*Object :* to increase the theoretical knowledge of the staff and prepare them for the competitive examinations for supervisory staff.

Special retraining centres have been set up for instructing the staff about Diesel traction.

- c) — Practical training in service.  
— Evening classes and retraining centres (see above).  
— No reply.  
— No reply.  
— No reply.
- d) Regulations bearing upon the staff statutes (wages, promotion, pensions) are distributed.

- e) General instructions are published in the monthly bulletin sent round to all the departments.

g) *Madagascar Railways.*

- a) One to three years apprenticeship for workmen.  
 b) Yes, improver courses.  
 c) — Practical and theoretical.  
     — No schools as yet.  
     — Vary according to the job.  
     — Finishing stage provided for with the S.N.C.F.  
     — No.  
 d) Yes, but very summary.  
 e) No.

h) *Viet-Nam Railways.*

- a) For certain candidates (Permanent Way and Rolling Stock) preliminary training is required before engagement.  
 b) For other candidates (Operating) training after engagement.  
 c) Theoretical and practical instruction for three months in the Company's schools.  
 d) Yes.  
 e) The regulations are not distributed but can be read in the works.

i) *Cambodian Railways.*

- a) Training before engagement for telegraph clerks (Operating), permanent way inspectors (Permanent Way).  
 b) No; finishing courses for station and train staff.  
 c) For the staff covered by a) : theoretical and practical training for three months in a school managed by the Administrations.  
 d) No.  
 e) No. Can be consulted in the offices of the heads of departments.

## 6. Italy.

a) *State Railways.*

- a) For certain categories, direct admission to the job.  
 b) For others, preliminary training or training after engagement.  
 c) Training covers :  
     — A professional 8-months course with an examination at the end for assistant drivers.  
     — A professional 2-years course or longer with an examination at the end for assistant station-masters and operating department pupils.  
     — 6 months course for drivers.  
     — Preparatory and professional training courses for other categories (interpreters, technical managers, etc.).  
 d) These matters are covered in the professional courses mentioned.  
 e) Manuals dealing with these various points are supplied free to pupils and at a low price to other employees.

b) *North of Milan Railway.*

No reply.

## 7. Luxembourg.

*Luxembourg National Railways Company.*

- a) No.  
 b) Yes.  
 c) In general, practical training and exceptionally training at an establishment of a neighbouring system.  
 d) No.  
 e) The regulations concerning sickness benefit are distributed to employees.

## 8. Netherlands.

*Netherlands Railways.*

- a) Training takes place after engagement.  
 b) Immediate training after engagement for

certain categories and at a later date for others.

Members of the staff employed in the intermediate grades receive two years schooling. They get a practical training and a course at one of the railway schools.

- c) No practical training; only training for certain employees in the railway schools. The length of the training period varies with the job.

No training in other establishments.

- d) Certain courses deal briefly with the history of the undertaking, its policy, wages, promotion, etc.

- e) Recruits receive a collection of the regulations giving the conditions of admission and cessation of employment and a copy of the rules for the prevention of accidents at work.

## 9. Portugal.

### *Portuguese Railways Company.*

- a) No.
- b) Yes.
- c) — Workmen : practical training in a school.  
— Clerical staff : practical training.  
— Period varies.  
— No training in other establishments.  
— Permanent Way staff are recruited from the temporary staff after a trial training of 2 or 3 months.
- d), e) In general, candidates know the rules about wages, promotion, pensions, medical services and benefits.

## 10. Switzerland.

### a) *Federal Railways.*

- a) Yes, but only in the case of apprentices for station and train staff jobs.
- b) In most cases.
- c) Practical training of varying duration according to the case. The employee is often responsible for acquiring for him-

self the theoretical knowledge essential to his job.

- d), e) — Each employee gets a copy of the necessary regulations.

— The Administration publishes a paper (*Bulletin of the Federal Railways*) with the object :

- of guiding the staff and keeping them advised of the state of affairs, and  
— supplying information of a technical nature intended to complete their training.

### b) *Rhaetian Railway.*

- a) Yes.

- b) No.

- c) — Practical and theoretical training.

— No.

— Station staff : 2 years.

Train staff : one year.

— No.

— Apprenticeship for fitters in the shops : 4 years.

The courses at the professional school are obligatory.

- d) No.

- e) Yes.

## 11. Syria.

### a) *Damas-Hamah Railway.*

No reply.

### b) *Syrian State Railways.*

Workmen are engaged on the spot as auxiliary staff for an indefinite period.

Must be more than 18 years old.

Practical training after engagement.

## 12. Turkey.

### *Turkish Railways.*

Before entering the service of the railway, candidates promise to observe the administrative regulations.

- a) Yes, especially in the case of staff responsible for the running of trains in the stations.



- b) Yes with professional finishing courses for certain jobs.
- c) — Practical training of a variable duration according to the job.  
— No schools managed by the Administrations.
- d) The staff must make itself familiar with the regulations concerning the relations between employees and the Company as well as those governing their employment.

At the present time there is no theoretical instruction.

- e) Yes.

### QUESTION 6.

*What is the probationary period, if any? Are any examinations carried on during this period? Are in certain cases pass out examinations required at the end of this period?*

### REPLIES.

The following table 8 shows that the length of the probationary period is extremely variable, that interviews during this period are the rule on nearly half the railways, as are final examinations.

TABLE 8. — Probationary trial period.

RAILWAYS	Duration	Final examination	Interviews
<i>Deutsche Bundesbahn</i>	1 year	no	no
<i>Austrian Rys.</i> .....	...	yes	no
<i>S.N.C.B.</i> .....	6 months or 1 year	for certain jobs	for certain jobs or profess. courses
<i>S.N.C.V.</i> .....	3 months labourers; 1 year clerks	for certain jobs	no
<i>Otraco.</i> .....	6 months labourers; 15 months clerks	yes	no
<i>R.E.N.F.E.</i> .....	1 month to 2 years	examination for regularisation in certain cases	no
<i>S.N.C.F.</i> .....	1 year	no	for certain jobs
<i>R.A.T.P.</i> .....	1 year of utilisation on a 15 months period	no	yes
<i>Algerian Rys.</i> .....	1 year	no	no
<i>Gafsa Ry.</i> .....	1 year	for certain jobs	no
<i>Tunisian Rys.</i> .....	1 year	for jobs involving safety	no
<i>West African Rys.</i> ...	1 year	no	no
<i>Madagascar Rys.</i> ...	1 year	yes	yes
<i>Indochina Rys.</i> .....	2 years	yes	no
<i>Cambodian Rys.</i> ....	2 years	yes	no
<i>Italian Rys.</i> .....	1 year	no	for certain jobs
<i>North of Milan Ry.</i> .	...	...	...
<i>Luxemburg Rys.</i> ....	variable	no	yes
<i>Netherlands Rys.</i> ....	variable	generally	no
<i>Portuguese Rys.</i> .....	labourers 6m.; clerks 1 year skilled lab. 3 years appr.	yes	yes
<i>Swiss Federal Rys.</i> ..	appr. 2 years; trial 1 year	yes	no
<i>Rhaetian Ry.</i> .....	1 year	no	no
<i>Damas Ry.</i> .....	...	...	...
<i>Syrian Rys.</i> .....	...	...	...
<i>Turkish Rys.</i> .....	lab. : 1 month; clerk 6 months	generally	no

## QUESTION 7.

*Do replies to 1 to 6 above apply equally to :*

a) *temporary and permanent staff?*

b) *clerical and wage grades?*

*If not, indicate the extent to which the methods vary for the different classes of staff.*

REPLIES (see Table 9).

## QUESTION 8.

*Do temporary or former temporary employees receive any special consideration if they apply for a permanent job?*

## REPLIES.

All railways replied in the affirmative except the R.A.T.P., Cambodian Railways and Syrian State Railways.

Such priority is given in fact, though not in right, on the Deutsche Bundesbahn, R.E.N.F.E., Madagascar Railways, Swiss Federal Railways and Damas-Hamah Railway.

The Italian Railways increase the marks gained in the competitive examinations.

## QUESTION 9.

*Indicate the promotions which can take place within the wage grades before*

TABLE 9. — Application of recruiting methods.

RAILWAYS	Permanent	Temporary	Clerk	Workmen
<i>Deutsche Bundesbahn</i>	yes	simpler methods	for the technicians diplomas	...
<i>Austrian Rys. ....</i>	yes	no	yes	yes
<i>S.N.C.B. ....</i>	yes	yes	competition	seldom
<i>S.N.C.V. ....</i>	yes	yes	competition	by competition
<i>Otraco ....</i>	yes	yes	administrative knowledge	no competition technical knowledge
<i>R.E.N.F.E. ....</i>	yes	recr. by contract without spec. formalities	yes	yes
<i>S.N.C.F. ....</i>	yes	simpler methods	yes	yes
<i>R.A.T.P. ....</i>	yes	yes	yes	yes
<i>Algerian Rys. ....</i>	yes	yes	yes	yes
<i>Gafsa Ry. ....</i>	yes	yes	yes	yes
<i>Tunisian Rys. ....</i>	yes	simpler methods	yes	yes
<i>West African Rys ...</i>	yes	no	yes, for permanent staff	yes, for permanent staff
<i>Madagascar Rys ...</i>	yes	no	yes	yes
<i>Indochina Rys. ....</i>	yes	no, more flexible	yes	yes
<i>Cambodian Rys. ....</i>	yes	no	yes	yes
<i>Italian Rys. ....</i>	yes	no tempor. staff	yes	yes
<i>North of Milan Ry. .</i>	...	...	...	...
<i>Luxemburg Rys. ....</i>	yes	yes	yes	yes
<i>Netherlands Rys. ....</i>	yes	no fixed method	yes, for permanent staff	yes, for permanent staff
<i>Portuguese Rys. ....</i>	yes	no	yes	yes
<i>Swiss Federal Rys. ..</i>	yes	no	yes	yes
<i>Rhaetian Ry. ....</i>	yes	yes	yes	yes
<i>Damas Ry. ....</i>	...	...	...	...
<i>Syrian Rys. ....</i>	yes	yes	yes	yes
<i>Turkish Rys. ....</i>	yes	no	yes, for permanent staff	yes, for permanent staff

*reaching supervisory level. What factors are taken into account in deciding such promotions? Is responsibility for such promotions always a departmental one?*

*Can a member of the wage grades receive promotion to the clerical grade? Under what circumstances?*

## REPLIES.

### 1. Western Germany.

#### *Deutsche Bundesbahn.*

Labourers can be promoted to the grade of overseer or gang foreman. The supervisory jobs are reserved for officials.

Ability is the decisive factor in such promotions, but some account is also taken of seniority.

Promotions depend upon the department concerned.

### 2. Austria.

#### *Austrian Federal Railways.*

Labourers can be promoted to leading ganger, gang foreman, shop foreman.

On the Austrian Federal Railways all permanent staff are classed as employees.

### 3. Belgium and Colony.

#### *a) Belgian National Railways Company.*

Unskilled labourers can become skilled labourers either after they have successfully passed a professional test (test job) or a given examination (for example : electrician).

Chief tradesman's jobs are allocated according to seniority in the grade in question to the most capable men.

A labourer can become a clerk if he passes the necessary examination.

In general members of the staff, temporary, provisional or permanent, have priority in the competitive examinations.

#### *b) National Light Railways Company.*

An unskilled labourer can become a skilled labourer or first class workman on passing an ability test.

Exceptionally, a labourer can become a clerk by his own efforts when he has obtained the necessary qualifications and skills.

The factors taken into consideration in granting supervisory jobs are : seniority, technical skill and ability to give orders.

#### *c) Otraco.*

The labourers can become 1st class workmen or chief workmen.

The quality of work and seniority are taken into account in deciding such promotions.

The promotion is put forward by the management and approved by the administration.

In principle, a workman cannot become a clerk.

### 4. Spain.

#### *Red Nacional de los Ferrocarriles Españoles.*

Before being promoted to the supervisory staff, workmen can reach the higher grades in their category by successfully passing an examination, or on account of seniority and merit.

### 5. France and French Union.

#### *a) French National Railways Company.*

Labourers, whether skilled or unskilled, can be promoted to the highest grades in such categories after they have successfully passed the necessary examinations and professional tests.

Such promotions follow the order established each year from the marks given for aptitude for the job desired, with an increase of a quarter of a mark for each year's seniority in the grade concerned.

Promotions are given by the Regional Manager within the limits authorised.

Labourers are entitled to take competitive examinations or tests to qualify as clerks.



b) *R.A.T.P.*

Promotions :

Specialist workmen;

Professional workmen;

Skilled workmen;

Highly skilled workmen.

Seniority and estimated professional value, with a test or competitive examination according to the case.

Promotions are decided by the General Manager at the suggestion of the Departments concerned.

All executives are able to change their jobs provided they satisfy the conditions and qualifications laid down for the requested job.

c) *Algerian Railways.*

Promotions take place within each grade.

For promotion to a higher grade, an aptitude mark is granted, which includes :

1) a mark for actual aptitude : qualities and knowledge needed for the higher grade;

2) extra for seniority : a quarter of a mark for each year.

Promotions are suggested by the head of the Department and approved by the Manager.

A labourer can become a clerk by lateral transfer, provided he passes the necessary competitive examination to this standard.

d) *Gafsa Railway.*

Workmen can be promoted to supervisory jobs on the basis of the aptitude tables and after holding discussions with the staff delegates.

Qualities of leadership and organising ability are taken into account.

The final decision rests with the manager.

It is possible for a workman to become a clerk, but priority is given to those who have been wounded or are ill so that they cannot no longer work actively, if they have the necessary ability.

e) *Tunisian Railways.*

Workmen and executives have to pass through several grades before getting supervisory jobs.

Factors which are taken into account : professional test for workmen; examination for book-keepers (for example); notes on ability in other cases.

A workman may be promoted to the grade of clerk if he has the necessary ability.

f) *French West African Railways.*

There are six grades of executives : 3 of workmen, 2 of chief workmen and one of master workman.

Promotions are granted by the Regional Manager at the suggestion of the head of the Department and on the advice of the competent committees.

A minimum of 2 years service in each grade.

Ability outweighs seniority.

A workman can become a clerk provided he successfully passes the competitive examination for this grade.

g) *Madagascar Railways.*

Workmen are promoted step by step as on the S.N.C.F.

Professional ability is the most important factor.

Promotions are decided by the Manager on the advice of the parity grading committees.

In principle, the staff spend all their working lives in the same department.

h) *Viet-Nam Railways.*

After being engaged as assistant-workman, the employee can become specialist workman, professional workman and master-workman.

Such promotions are decided by the managements concerned.

Exceptionally a workman may be promoted to clerk when he has held a job of this kind.

i) *Cambodian Railways.*

A workman can become a clerk provided he successfully passes an examination.

**6. Italy.**a) *State Railways.*

Before obtaining, by means of a competitive examination the qualifications of supervisory staff, workmen of whom there is favourable report can become first class workmen after successfully passing an examination.

They cannot be promoted into the grade of clerks.

b) *North of Milan Railway.*

Workmen can be promoted five times before qualifying for supervisory jobs.

Such promotions are granted according to ability and decided by the Management.

A workman can become a clerk provided he successfully passes an examination or produces the necessary education diploma.

**7. Luxemburg.***Luxemburg National Railway Company.*

Workmen can qualify for supervisory jobs by means of examinations.

Apart from promotions in grades 1 and 2, jobs in grade 3 and above this grade can only be obtained after successfully passing an examination.

**8. Netherlands.***Netherlands Railways.*

Workmen can become skilled workmen (or similar) and chief-workman (or similar).

Seniority is taken into account as well as ability in granting such promotions. They are suggested by the Departmental Heads and approved by the Management.

A workman cannot become a clerk unless he has given proof of exceptional ability.

**9. Portugal.***Portuguese Railways Company.*

## Promotions :

— Skilled labourers; assistant-workman, 3rd, 2nd and 1st class workman;

— Lowest grades of supervisory jobs : by means of a competitive examination only open to men with 4 years service as 1st class workman, whose immediate superior has given a good report of their professional ability, behaviour and discipline;

— Train staff : 2nd and 1st class brakemen; 2nd and 1st class conductors; chief conductors;

— Locomotive staff : 2nd and 1st class firemen, 3rd, 2nd and 1st class drivers, head drivers;

— Diesel locomotive staff : recruited from amongst the steam locomotive staff after they have attended the necessary school; ability test and three months probationary period;

— Rail motor coaches; 3rd, 2nd and 1st class rail motor coachmen; recruited from amongst the shop or locomotive staff after attending a course, passing an ability test and a 3 months probationary period.

Promotions are suggested by the departments : the decision depends on the general management.

Workmen can become clerks, by means of competitive examinations, but get no priority.

Vacancies are not published; the men put in for a job and are granted it as vacancies occur.

**10. Switzerland.**a) *Federal Railways.*

There is a competitive examination for every job.

Vacancies are published in the staff notices.

Ability alone is taken into account; seniority only plays a secondary part.

In the case of locomotive-staff, there are special instructions in which age is taken into account chiefly.

In several departments, promotion to a higher grade depends on passing an examination.

The staff have *no legal right* to promotion.

A labourer, who is no longer able to do his work, can become clerk after a trial period in an administrative or technical office.

#### b) *Rhaetian Railway.*

Possibilities of promotion vary in each department. The chief factors are capacity and character.

All promotions depend upon the management.

Within certain limits, a permanent way labourer can become a station labourer; a station labourer with office experience can become station keeper.

### 11. Syria.

#### a) *Damas-Hamah Railway.*

Promotions depend upon merit and seniority; in the case of supervisory jobs, there is in addition an examination.

#### b) *Syrian State Railways.*

There are 4 promotions for labourers :

- 1st class workman;
- exceptional class workman;
- 2nd class foreman;
- 1st class foreman.

Promotions are granted according to seniority, professional merit and service given.

They are decided by the general management upon the recommendation of the department concerned.

The promotion of a labourer to the grade of clerk depends on the appreciation of the general management.

### 12. Turkey.

#### *Turkish Railways.*

The usual promotion of labourers is as follows :

Assistant workman; 2nd class then 1st class workman; 2nd and then 1st class supervisor; 2nd then 1st class foreman, chief fitter (higher grade).

The factors taken into account are : knowledge, ability and character.

The local head and the head of the central department decide promotions together.

After attaining the grade of 1st class foreman, it is possible to transfer to a clerical job.

### QUESTION 10.

*What is the procedure for advancement up the clerical scale? How are vacancies advertised? What factors are considered in deciding on promotions? Is ability or seniority regarded as the more important?*

*Has an examination to be passed before promotion can take place?*

### REPLIES.

#### 1. Germany.

##### *Deutsche Bundesbahn.*

After being engaged provisionally, the staff pass examinations to qualify for the jobs they wish to have. Their promotion to the different grades of this category depends either on the results of an examination or on seniority.

In general, they have to spend a certain period in one grade before being promoted to a higher grade.

#### 2. Austria.

##### *Austrian Federal Railways.*

Vacancies are published.

Ability is taken into account, and seniority is secondary.

Ability is determined by the results of examination passed before the vacancy occurs.



### 3. Belgium and Colony.

#### a) *Belgian National Railways Company.*

Promotion to another grade depends on the vacancies occurring.

Officials and clerks in grades from which there is normally promotion to a higher grade obtain such promotion by means of a declaration of ability. This is obtained from the « ability » description held by the employee concerned.

Employees belonging to a closed grade can obtain promotion to certain higher graded jobs by means of a competitive examination.

Vacancies are not published.

An employee put forward for a better job is consulted in order to make a note of the job he would prefer.

An employee in a grade job which normally leads to promotion can obtain this if he fulfils the following conditions :

1) an ability report of at least 16 marks out of 20;

2) does not exceed the age limits laid down in the regulations;

3) belongs to the subdivision in which the vacancy occurs.

Candidates having an ability quota of 16 out of 20 or more for at least two years have priority.

The order of promotion depends on seniority in the grade.

There are special arrangements for promotion to jobs requiring special skills.

— As a whole, a negative reply. In general, promotion to a higher grade job depends upon ability and seniority.

In the case of certain jobs (chief guard, 1st class book-keeper and the like) promotion depends on successfully passing a written test.

#### b) *National Light Railways Company.*

Employees are promoted in grade on passing examinations. Successful candidates

form the reserve from which one is selected in order of seniority when a vacancy occurs.

Vacancies are published.

The main factor in promotion is seniority as well as technical and psychological ability.

Ability is the most important factor.

#### c) *Otraco.*

Promotion depends on the vacancies occurring. These are not published. They are the result of changes of staff (retirement, sickness, promotion to another job, etc.).

Ability and seniority are taken into account, ability being the most important.

No examinations have to be passed to obtain promotion.

### 4. Spain.

#### *Red Nacional de los Ferrocarriles Españoles.*

Vacancies are brought to the notice of the staff.

Promotions are granted on the results of examinations or the qualifications of the candidate (diplomas, ability, seniority).

Ability and seniority are taken into account. Ability seems to be the most important.

### 5. France and French Union.

#### a) *French National Railways Company*

Promotion follows similar lines as in the case of workmen.

Nominations are put forward according to the grade by the head of the area or the head of the regional department.

Ability is the determining factor.

#### b) *R.A.T.P.*

Promotion in the case of the operating staff depends on competition according to qualifications.

Vacancies are brought to the notice of the staff.

Qualified candidates can obtain promotion to vacancies according to their seniority.

c) *Algerian Railways.*

The procedure is identical for clerks as for labourers.

Vacancies due to differences between jobs available in the grades and the personnel available are noted at the beginning of the working year and brought to the knowledge of the staff delegates by the ability table.

The most important factor is ability for the job in question.

Examinations are required in certain cases to obtain promotion. The fact that an examination has been successfully passed does not affect the ability rating attributed to the employee subsequently.

d) *Gafsa Railway.*

Promotion depends on the ability table which is drawn up after discussions with the staff delegates.

Ability is the most important factor, though seniority is taken into account to some extent.

There are promotion examinations only in the case of certain jobs.

e) *Tunisian Railways.*

Each year an ability table is prepared for each job to be filled according to the vacancies occurring.

Ability is gone into in committee in the presence of the staff delegate.

In certain cases a preliminary competitive examination is held.

The ability tables are drawn up by the Manager.

f) *French West African Railways.*

Promotion is granted by the Regional Manager on the suggestion of the head of

the department and on the advice of two committees.

At least two years service in each grade is required.

Apart from promotion in grade, there is a set scale of wage increases.

Ability is of greater importance than seniority.

In the case of promotion beyond grade 6, an examination is required.

g) *Madagascar Railways.*

The procedure is the same as on the S.N.C.F.

The entries on the ability table are made according to the number of vacancies in the following year plus 25 %.

Dominant factor : professional ability.

Examinations are organised for promotion in certain cases.

h) *Viet Nam Railways.*

Promotion of employees is the result of examinations and competitive tests completed by an ability quota.

Tests cover general knowledge and/or professional knowledge.

Vacancies are covered in the ability tables.

i) *Cambodian Railways.*

Promotion depends on the ability table which is based on the ability marks given at the end of the year.

The ability quota is increased according to seniority.

Inclusion in the ability table depends on successfully passing an examination.

## 6. Italy.

a) *State Railways.*

The number of vacancies to be filled is decided annually.

Promotions to the first grade are decided

by the general manager and for other grades by comparative ability, either seniority and ability or seniority only.

The criteria of comparative ability is decided by the promotion committees who check the necessary qualities.

For certain categories of jobs, one third of the vacancies are filled by a competitive examination to speed up the promotion of employees in certain conditions.

For other categories of jobs an ability test is required. The order in which candidates pass this test decides the order in which they get promotion.

#### b) *North of Milan Railway.*

Promotions : once a year to fill any vacancies.

Promotion depends upon seniority in the lower grades, and on ability in the higher grades.

There is an examination before appointment to certain jobs (yard manager, driving staff, train staff).

### 7. Luxembourg.

#### *Luxembourg National Railways Company.*

Promotions depend on the order in which candidates passed an examination.

Vacancies are advised in writing to the candidates concerned. The latter can accept or refuse any job offered.

### 8. Netherlands.

#### *Netherlands Railways.*

The promotion of employees like that of the workmen depends on seniority and ability, and for certain grades the successful passing of certain tests.

Vacancies in the lower grades are announced in the press.

### 9. Portugal.

#### *Portuguese Railways Company.*

*Station staff :* In the case of beginners, 3rd, 2nd and 1st class clerks and 3rd, 2nd

and 1st class and chief station masters, promotion depends on examinations or tests, ability, behaviour and seniority also being taken into account. The latter is not the most important factor.

*Office staff :* 3rd, 2nd, 1st class and head clerks, section heads, assistant distribution heads, distribution heads. Normal promotion takes place without any competitive examination after 4 years in the job, taking into account seniority, ability, behaviour and discipline.

### 10. Switzerland.

#### a) *Federal Railways.*

All jobs are competed for.

Vacancies are announced in the staff notices.

Only ability counts; seniority is only of secondary importance.

In the case of train staff (guards) special regulations also take age into account.

In several departments, promotion to a better job depends upon passing an examination.

Employees have *no legal right* to promotion.

#### b) *Rhaetian Railway.*

Vacancies are announced by circulars.

The determining factors for promotion are first of all ability and then seniority.

No examinations have to be passed to get promotion.

### 11. Syria.

#### *Damas-Hamah Railway.*

There are no promotion examinations for the staff.

Promotion depends upon ability and seniority.

### 12. Turkey.

#### *Turkish Railways.*

By employees we mean staff having the



status of superannuated staff (officials) unlike other personnel who from the point of view of allocations and other rights are not covered by the Administration wages scale, but whose numbers and pay is fixed in the annual budget.

Promotion of employees (officials) is laid down in the law on the wages scale.

They have to spend a minimum of three years in each grade.

There are annual rises for seniority.

The determining factors in promotion are seniority, ability and behaviour.

Ability is of greater importance than seniority.

#### QUESTION 11.

*Are periodic re-examinations carried out in the clerical grades to assess progress? Do the most successful re-examinees receive any encouragement by way of monetary reward or otherwise? What happens to unsuccessful re-examinees?*

#### REPLIES.

Periodical examinations are required by:

— The Austrian Federal Railways for traffic, train and signalling staff.

— The French National Railways, Tunisian Railways and Viet Nam Railways for certain jobs concerned with safety.

— The Portuguese and Turkish Railways for certain jobs.

On the Portuguese Railways only, encouragement is given in the form of premiums.

Employees, who fail their periodic examinations, lose their jobs on the Austrian Railways and Tunisian Railways; their promotion is held up on the Turkish Railways.

#### GROUP 3.

**Recruiting of administrative and technical officials and supervisory staff.**

#### QUESTION 1.

*Are vacancies in :*

- a) *administrative and executive grades?*
- b) *technical and scientific grades?*

c) *supervisory grades?*

*filled exclusively from the undertaking's personnel, or is there any recruitment from outside, such as University Graduates? If from both sources, is there any fixed proportion of one to the other?*

#### REPLIES.

Table 10 hereafter sums up all the useful data received and needs no further comment.

#### QUESTION 2.

*Is there any method of assessing potential talent of all available personnel from whom higher positions might be filled? What does it involve?*

Such an evaluation takes place on the results of an examination or test on the following railways: Deutsche Bundesbahn, Austrian Federal Railways, Belgian National Railways, National Light Railways Company, French National Railways, R.A.T.P., Algerian Railways, French West African Railways, Viet Nam Railways, Cambodian Railways, Damas-Hamah Railway, and (or), in addition the heads of departments give their estimate on the following railways: Belgian National Railways, National Light Railways Company, R.E.N.F.E., S.N.C.F., R.A.T.P., Algerian Railways, Gafsa Railway and Cambodian Railways, Italian State Railways, North of Milan, Netherlands, Portuguese and Swiss Federal Railways and Turkish Railways.

On the Belgian National Railways there are two ways of getting a better job:

1) by means of an examination — in the case of employees who when engaged did not have anything to show that they possessed the general and special knowledge required for the higher grade job;

2) an ability quota — in the case of men normally being promoted to a higher grade, on the grading of their immediate superior and approved by the manager (in the case of technical, administrative or supervisory staff). This quota takes into account the

TABLE 10. — Filling of vacancies.

RAILWAYS	From amongst railway staff	From outside sources	Percentage
<i>Deutsche Bundesbahn</i>	generally	certain higher posts	equilibrium is sought after
<i>Austrian Rys.</i> . . . . .	yes, in the case of the higher jobs		
<i>S.N.C.B.</i> . . . . .	generally	doctors, engineers, lawyers, secretaries, departmental heads	
<i>S.N.C.V.</i> . . . . .		from both sources	
<i>Otraco.</i> . . . . .		from both sources	
<i>R.E.N.F.E.</i> . . . . .	yes		1/3 to 1/2 from outside sources at most
<i>S.N.C.F.</i> . . . . .	yes, generally for the lower jobs	for the managerial and higher grades	
<i>R.A.T.P.</i> . . . . .		from both sources	
<i>Algerian Rys.</i> . . . . .	generally	certain vacancies are reserved for university students	<i>Technical and administrative grades</i> 60 % recruited from outside sources <i>on qualifications</i> : engineers and certain university diplomas 20 % internal competitive examinations for all the staff or only for certain categories 20 % by choice, amongst supervisory staff meeting certain conditions of seniority <i>Supervisory staff</i> : 80 % by competitive examination open to qualified employees of the department concerned 20 % admission <i>on qualifications</i> , candidates holding certain diplomas
<i>Gafsa Ry.</i> . . . . .	generally	when no qualified employee is available	
<i>Tunisian Rys.</i> . . . . .	in principle	exceptionally in the case of certain technical officials	
<i>West African Rys.</i> . . . .	generally	when no railway candidates are available	
<i>Madagascar Rys.</i> . . .	mostly	sometimes in the case of technical jobs for which a diploma is required	
<i>Indochina Rys.</i> . . . . .		from both sources	percentage fixed by the Ministry each year
<i>Cambodian Rys.</i> . . . .	generally	when there are no qualified employees available	
<i>Italian Rys.</i> . . . . .		from both sources	
<i>North of Milan Ry.</i> . . .	generally	higher administrative and technical jobs. university graduates	
<i>Luxemburg Rys.</i> . . . .		from both sources	
<i>Netherlands Rys.</i> . . . .	certain jobs are reserved for the railway staff	usually	
<i>Portuguese Rys.</i> . . . . .	exclusively	no	
<i>Swiss Federal Rys.</i> . . .	no, except in the case of ordinary promotion	all jobs are competed for	
<i>Rhaetian Ry.</i> . . . . .	generally	technical staff	
<i>Damas Ry.</i> . . . . .			
<i>Syrian Rys.</i> . . . . .			
<i>Turkish Rys.</i> . . . . .		first grades of administrative and technical staff from both sources	

general education, behaviour, character, physical and professional capacity and any reprimands earned.

If necessary, the employee is questioned as to his professional knowledge.

A minimum quota of 16 out of 20 is required.

There is a probationary period of 6 months to one year for each employee promoted to a higher grade.

The National Light Railways Company combines selection tests with an ability report.

On the Madagascar Railways, employees are graded according to the service they give or could give.

On the Luxemburg National Railways, ability is taken into account.

### QUESTION 3.

*If recruitment is not exclusively from the undertaking's personnel, what is the source of supply, i.e. professions, Universities, Technical Schools, etc.?*

### REPLIES.

It can be stated that in practice all the railways recruit staff from the Universities or High Schools and Technical Schools.

Only the Deutsche Bundesbahn does not have to seek staff from any outside sources thanks to the number of candidates who take the State examinations.

Otraco and the Turkish Railways recruit candidates also from the liberal professions.

Finally, it may be mentioned that there is always a supplementary source of candidates available to the French West African, Madagascar, Viet Nam and Cambodian Railways from the French National Railways Company or French Overseas Railway Office.

### QUESTION 4.

*Is there a systematic method of selection?*

*If so, does it include :*

a) *a job specification of vacancies arising*

*describing the work and the requirements needed to do it properly?*

b) *any attempt to create a pool of qualified persons to balance expected vacancies?*

c) *advertising of vacancies :*

*— within the undertaking?*

*— outside the undertaking?*

d) *utilisation of sources of information of all kinds concerning candidates?*

e) *an Interview Board, other than selection Board, to assist in assessing the general merits of candidates?*

f) *is there a screening test carried out? What does it involve? Who carries out this test? Give full details.*

g) *is a psychological examination made? If so, by whom, i.e. specially trained personnel or outside industrial psychologists? What success has attended their use?*

### REPLIES.

#### 1. Germany.

*Deutsche Bundesbahn.*

a) There is no set rule, but the conditions are laid down for each job.

b) The reserve consists of enrolled candidates.

c) No reply.

d) Education certificates as well as character testimonials are required.

e) For the higher grades of non-technical jobs, a preliminary selection is made on qualifications, followed by a personal selection by means of interviews.

g) Administrative and technical staff do not undergo any psychotechnical examination.

#### 2. Austria.

*Austrian Federal Railways.*

There is no systematic method of selection.



Recruiting takes place by category.

Candidates get a general training which enables them to be employed in any job.

a), b) No.

c) Announced within the undertaking.

d) Police certificates and references required in the case of employee's sons.

e), f) No.

g) Candidates who have completed their higher studies do not have to pass any psychotechnical examination.

### 3. Belgium and Colony.

a) *Belgian National Railways Company.*

a) There are no set rules for the different jobs.

b) The lists of successful candidates drawn up after each competitive examination are valid for two years; after the initial recruitment, any names left on the list form a reserve from which the Company can select men for vacancies occurring within the two years.

In the case of jobs requiring an ability quota, the reserve is composed of those having 16 marks out of 20.

c) Competitive examinations held exclusively for the staff are announced within the undertaking; examinations open both to employees and other candidates are announced within the undertaking and outside it.

d) On engagement a character testimonial is required; in addition the military record of those who have completed their army training.

e), f) No.

g) Technical and administrative staff as well as the supervisory staff do not have to undergo psychotechnical examinations.

b) *Belgian National Light Railways.*

a) The regulations drawn up by the State are used.

b), c) Yes.

d) Yes; ability report on employees; minimum guarantees in other cases.

e) No.

f) Yes. The Staff Manager or his delegate interviews candidates in order to judge the maturity and psychological qualities of the employee.

c) *Otraco.*

a) No.

b) Yes.

c) — No.

— Yes.

d) Yes.

e) No.

f) Yes. Carried out by a qualified member of the higher categories of staff.

g) Before engagement, a psychotechnical examination is made by an outside specialist. This method has proved satisfactory.

### 4. Spain.

*Red Nacional  
de los Ferrocarriles Españoles.*

a) No.

b) In certain cases, the number of vacancies is not fixed. The successful candidates who do not get jobs form a reserve.

c) Vacancies are announced within the undertaking or outside if necessary.

d) In the case of candidates from outside sources : a diploma and character testimonial, etc.

e), f), g) No.

### 5. France and French Union.

a) *French National Railways.*

a) No.

b) The reserve consists of the list of employees who have successfully passed the necessary competitive examinations or

tests and obtained a sufficiently high ability quota to qualify for a better job.

- c), d), e), f) Pupils at technical schools aged 18 and over are allowed to take a 15 days instruction course during the summer holidays.

*Object :*

- 1) To enable them to appreciate the position held by the railway in the general economy;
  - 2) To get some idea of its working.
- Pupils of the large technical schools who wish to have a railway career can take a 4 weeks introductory course during the summer holidays before their final year at school.

*Object :*

- 1) To instruct them in the general organisation;
  - 2) To get an idea of the ability of the candidate.
- Holders of diplomas who have worked this 4 weeks course are interviewed by a higher official.

They are accepted or rejected by the technical managers or managers of the areas concerned on the basis of :

- the interview with the official mentioned above;
- information supplied by the school;
- the record of the 4-weeks course;
- vacancies to be filled in the areas.

- g) No psychotechnical examinations are held.

b) *R.A.T.P.*

- a) The conditions of physical ability to be fulfilled are laid down in the regulations.
- b) Recruiting by competitive examination : the standard is fixed on the basis of the vacancies expected to occur during the coming year. Recruiting by selective promotion; the number of employees entered on the ability tables is 150 %.

- c) Vacancies are announced :
  - in the case of a competitive examination : by service notices;
  - in the case of selective promotion : to the staff delegates and members of the selection committees.

Vacancies are never published outside the railway.

- d) Candidates are interviewed in turn by the heads of the departments concerned and then by the staff manager or his assistant.

e) No.

f) Nothing.

- g) Each candidate undergoes a psychotechnical examination in the railway laboratory under the direction of qualified psychotechnical experts on the railway staff. The method is completely satisfactory.

c) *Algerian Railways.*

- a) Jobs are graded according to the physical ability required.
- b) Yes; employees from the next lowest grade whose names figure on the ability tables.
- c) Yes, when the staff get their ability rating. Yes, for all commencing jobs open to competitive examination when there are no suitable railway employees to promote.
- d), e), f), g) No.

d) *Gafsa Railway.*

- a) No.
- b) Sometimes.
- c) Rarely.
- d), e), f), g) No.

e) *Tunisian Railways.*

There is no systematic method of selection apart from the evolution of the ability of employees.

f) *French West African Railways.*

- a) Nothing.
- b) The reserve is formed of employees suitable for promotion.
- c) Nothing.
- d) Employees must get permission to take part in the competitive examinations.
- e) Nothing.
- f) Candidates from outside sources have to undergo a probationary period of not less than 12 and not more than 24 months.
- g) There are no psychotechnical examinations.

g) *Madagascar Railways.*

- a), b) No.
- c) Yes, from the Central Office of French Overseas Railways in Paris for higher grades of jobs and supervisory posts for which employees are generally recruited from the staff of the S.N.C.F. and allowed to work abroad.
- d), e), f), g) Nothing.

h) *Viet Nam Railways.*

The selection of candidates is so organised that the Company can make the best possible use of those who successfully passed the examinations.

- a), b) Yes.
- c) Yes.  
Yes if needs be.
- d), e), f), g) No.

i) *Cambodian Railways.*

- a) There are sets of regulations regarding the various jobs.
- b) The reserve consists of those figuring on the ability graphs.
- c) Vacancies are not published.
- d) An enquiry from the police.
- e), f), g) No.

## 6. Italy.

a) *State Railways.*

- a) No.
- b) The reserve consists of those who have successfully passed the examinations when promotion to an open job depends on passing such an examination.
- c) A recruiting and promotion programme is drawn up every year.
- d) Yes, before engagement.
- e), f), g) No.

b) *North of Milan Railway.*

There is a systematic method of selection for supervisory staff.

## 7. Luxemburg.

*Luxemburg National Railways Company*

- a), b) No.
- c) Vacancies are announced in the press when candidates are recruited from outside the railway.
- d), e), f) No.
- g) Yes; a psychotechnical examination is given by a professor of criminology not attached to the railway.

The method has given satisfaction.

## 8. Netherlands.

*Netherlands Railways.*

- a) No.
- b) A reserve is maintained in certain grades in expectation of vacancies occurring.
- c) Vacancies are published according to circumstances within the undertaking or outside.
- d) Candidates references are taken up.
- e) No.
- f) The head of the department concerned interviews all new recruits. The interview varies according to the job and person.



g) Outside candidates undergo a psycho-technical examination carried out by railway staff. The method has given satisfaction.

### 9. Portugal.

*Portuguese Railways Company.*

No systematic method is used to select candidates.

### 10. Switzerland.

a) *Federal Railways.*

a), b), c), d) Yes.

e) No.

f), g) Yes.

b) *Rhaetian Railway.*

The choice is adapted to each particular case.

### 11. Syria.

a) *Damas-Hamah Railway.*

No reply.

b) *Syrian State Railways.*

Nothing.

### 12. Turkey.

*Turkish Railways.*

a) Yes.

b) No. Strict necessity governs the labour employed.

TABLE 11. — Recruiting on production of a diploma.

RAILWAYS	Class of diploma	Public competitive examination	
<i>Deutsche Bundesbahn</i>	yes	no	...
<i>Austrian Rys.</i> .....	yes	no	...
<i>S.N.C.B.</i> .....	no	yes	...
<i>S.N.C.V.</i> .....	degree min. requested	eventually	...
<i>Otraco</i> .....	yes + experience + maturity	no	...
<i>R.E.N.F.E.</i> .....	yes	eventually	...
<i>S.N.C.F.</i> .....	yes	no	...
<i>R.A.T.P.</i> .....	yes, except in case of competitive exam.	yes	...
<i>Algerian Rys.</i> .....	yes	yes, holders of dipl. except.	...
<i>Gafsa Ry.</i> .....	yes	no	...
<i>Tunisian Rys.</i> .....	...	...	no special method
<i>West African Rys.</i> .....	yes	eventually	...
<i>Madagascar Rys.</i> .....	yes	yes	...
<i>Indochina Rys.</i> .....	yes	no	...
<i>Cambodian Rys.</i> .....	yes	no	...
<i>Italian Rys.</i> .....	increase of marks	yes	...
<i>North of Milan Ry.</i> .....	...	...	utilisation and appreciation of all references
<i>Luxemburg Rys.</i> ....	yes, except for holders of univ. dipl.	yes, except for holders of univ. dipl.	...
<i>Netherlands Rys.</i> ....	no	no	...
<i>Portuguese Rys.</i> .....	yes	no	...
<i>Swiss Federal Rys.</i> ..	yes	eventually	...
<i>Rhaetian Ry.</i> .....	yes	no	...
<i>Damas Ry.</i> .....	...	...	no special method
<i>Syrian Rys.</i> .....	diploma gives certain advantages	yes	...
<i>Turkish Rys.</i> .....	decide in case of ex-æquo	yes	...

The best men are selected from amongst the staff to fill vacancies in the higher grades.

- c) Both methods of publishing vacancies, according to circumstances.
- d) Yes, according to the importance of the job in question.
- e) There is no permanent nor special commission. Examinations committees are set up for competitive public examinations.
- f) This method is not used.
- g) Yes. A psychotechnical examination by psychotechnicians from the Administration's medical corps.

This method has proved satisfactory.

#### QUESTION 5.

*When a diploma is required, how do you proceed with the selection of candidates :*

- a) according to the type of degree of the candidate?

- b) *by means of an open competitive examination?*

#### REPLIES.

The Table 11 above shows that the majority of the railways take into account the class of diploma obtained (where a diploma is required).

This does not prevent a certain number of Administrations from organising competitive public examinations, for which the holding of a degree or diploma may or may not be a preliminary requirement.

#### QUESTION 6.

*Do these open competitive examinations consist of written, graphical and oral tests? Have you provided that for certain grades written or oral tests should be set to determine not only the knowledge of the applicants but their intellectual aptitudes and character?*

REPLIES (see Table 12).

TABLE 12. — Kind of test.

RAILWAYS	Written	Graphic	Oral	Maturity	No competitive examination
<i>Deutsche Bundesbahn</i>	...	...	...	...	×
<i>Austrian Rys.</i> .....	...	...	...	...	×
<i>S.N.C.B.</i> .....	×	eventually	eventually	eventually	...
<i>S.N.C.V.</i> .....	×	...	×	×	...
<i>Otraco.</i> .....	...	...	...	×	×
<i>R.E.N.F.E.</i> .....	×	×	×	...	...
<i>S.N.C.F.</i> .....	×	×	×	...	...
<i>R.A.T.P.</i> .....	×	...	...	...	no public competitive exam.
<i>Algerian Rys.</i> .....	...	...	...	...	×
<i>Gafsa Ry.</i> .....	...	...	...	...	×
<i>Tunisian Rys.</i> .....	...	...	...	...	×
<i>West African Rys.</i> ..	×	×	×	×	...
<i>Madagascar Rys.</i> ....	×	...	...	...	...
<i>Indochina Rys.</i> .....	×	×	×	...	...
<i>Cambodian Rys.</i> ....	...	...	...	...	no public competitive exam.
<i>Italian Rys.</i> .....	×	×	×	...	...
<i>North of Milan Ry.</i> ..	...	...	...	...	...
<i>Luxemburg Rys.</i> ....	×	...	×	...	...
<i>Netherlands Rys.</i> ....	...	...	...	...	×
<i>Portuguese Rys.</i> .....	...	...	...	...	seldom
<i>Swiss Federal Rys.</i> ..	...	...	...	...	×
<i>Rhaetian Ry.</i> .....	...	...	...	...	...
<i>Damas Ry.</i> .....	...	...	...	...	...
<i>Syrian Rys.</i> .....	×	...	seldom	...	...
<i>Turkish Rys.</i> .....	×	×	×	×	...

[illegible]



information provided by his diplomas, certificates, etc., or when special knowledge is required.

On the Turkish Railways, the importance of the job decides the question as to whether a maturity test is required.

On the Belgian National Railways, all competitive examinations include a written test covering general knowledge and if necessary professional knowledge.

Graphical tests are only organised in the case of certain technical jobs (engineers, section heads, draughtsmen and sometimes supervisory staff).

Oral tests are only required in the case of men who will come into contact with the public or be in charge (guards, telephone

operators, medical orderlies, social workers, supervisory staff). A practical test is also required in the case of supervisory jobs.

The National Light Railways Company always hold written tests and are pleased if the results are conclusive.

#### QUESTION 8.

*How do you set about recruiting personnel for vacancies in junior administrative and technical positions and for which vacancies a diploma is not required?*

REPLIES (See Table 13.)

#### QUESTION 9.

*If you effect your recruiting by open competitive examination, are your existing*

TABLE 14. — Priority in examinations and competitive examinations.

RAILWAYS	No public competitive examinations	Statutory	Temporary	Disabled persons, ex-servicemen, prisoners of war etc.	Competitive examination reserved for railway personnel	Choice lies with government agent	Increased quota rating	In cases of equal merit
<i>Deutsche Bundesbahn</i>	×	...	...	...	...	...	...	...
<i>Austrian Rys.</i>	×	...	...	...	...	...	...	...
<i>S.N.C.B.</i>	...	×	×	×	×	...	×	...
<i>S.N.C.V.</i>	...	×	×	...	×	...	...	...
<i>Otraco.</i>	×	...	...	...	...	...	...	...
<i>R.E.N.F.E.</i>	...	×	...	...	...	...	×	...
<i>S.N.C.F.</i>	...	...	...	...	×	...	...	...
<i>R.A.T.P.</i>	×	...	...	...	...	...	...	...
<i>Algerian Rys.</i>	...	...	...	...	...	×	...	...
<i>Gafsa Ry.</i>	×	...	...	...	...	...	...	...
<i>Tunisian Rys.</i>	...	...	...	...	...	...	...	...
<i>West African Rys.</i>	...	...	...	...	×	...	...	...
<i>Madagascar Rys.</i>	...	no priority		...	...	...	...	...
<i>Indochina Rys.</i>	...	...	...	...	...	...	×	...
<i>Cambodian Rys.</i>	...	...	...	...	...	...	...	...
<i>Italian Rys.</i>	...	...	...	...	...	...	×	...
<i>North of Milan Ry.</i>	...	...	...	...	...	...	...	...
<i>Luxemburg Rys.</i>	...	no priority		...	...	...	...	...
<i>Netherlands Rys.</i>	×	...	...	...	...	...	...	...
<i>Portuguese Rys.</i>	...	...	...	...	...	...	...	...
<i>Swiss Federal Rys.</i>	...	...	...	...	...	...	...	...
<i>Rhaetian Ry.</i>	×	...	...	...	...	...	...	×
<i>Damas Ry.</i>	...	...	...	...	...	...	...	...
<i>Syrian Rys.</i>	...	no priority		...	...	...	...	...
<i>Turkish Rys.</i>	...	...	...	...	...	...	...	×

*personnel given priority in any way?  
How?*

#### REPLIES.

The Table 14 above shows that many administrations (about one third) do not organise any public competitive examinations and that some organise competitive examinations solely for those already in their employment.

Amongst the remaining administrations,

there are some who do not grant any priority. The rest, finally, give priority or increased marks to certain categories of candidates.

#### QUESTION 10.

*On what do you base the syllabus of such examinations? Do these examinations include written, oral or graphical tests?*

REPLIES (see Table 15).

TABLE 15. — Programme of competitive examinations.

RAILWAYS	No competitive examinations	Nature and importance of the job	Basic general or technical knowledge	Scale	State programme of studies	Written	Oral	Graphical practical
<i>Deutsche Bundesbahn</i>	×	...	...	...	...	...	...	...
<i>Austrian Rys.</i> .....	×	...	...	...	...	...	...	...
<i>S.N.C.B.</i> .....	...	×	×	×	×	×	×	×
<i>S.N.C.V.</i> .....	...	×	...	...	×	...	...	...
<i>Otraco</i> .....	×	...	...	...	...	...	...	...
<i>R.E.N.F.E.</i> .....	...	×	×	...	...	×	×	×
<i>S.N.C.F.</i> .....	...	×	×	...	...	×	×	×
<i>R.A.T.P.</i> .....	×	...	...	...	...	...	...	...
<i>Algerian Rys.</i> .....	...	×	...	...	...	×	×	×
<i>Gafsa Ry.</i> .....	×	...	...	...	...	...	...	...
<i>Tunisian Rys.</i> .....	...	×	×	...	...	×	×	×
<i>West African Rys.</i> ..	...	...	×	...	...	×	×	×
<i>Madagascar Rys.</i> ...	...	×	...	...	...	×	×	×
<i>Indochina Rys.</i> .....	...	...	×	...	...	×	×	×
<i>Cambodian Rys.</i> .....	...	...	...	...	...	...	...	...
<i>Italian Rys.</i> .....	...	...	×	...	...	...	...	...
<i>North of Milan Ry.</i> ..	...	...	...	...	...	...	...	...
<i>Luxemburg Rys.</i> .....	...	...	×	...	...	×	×	...
<i>Netherlands Rys.</i> ....	×	...	...	...	...	...	...	...
<i>Portuguese Rys.</i> .....	...	...	...	...	...	...	...	...
<i>Swiss Federal Rys.</i> ..	...	...	×	...	...	...	...	...
<i>Rhaetian Ry</i> .....	×	...	...	...	...	...	...	...
<i>Damas Ry.</i> .....	...	...	...	...	...	...	...	...
<i>Syrian Rys</i> .....	...	×	...	...	...	×	...	...
<i>Turkish Rys.</i> .....	...	×	...	...	...	×	×	×

#### QUESTION 11.

*Are promotions based on seniority or suitability? In the last case, is an examination held? What is the syllabus of this examination?*

#### REPLIES.

Table 16 hereafter shows that nearly all the administrations put ability before seniority, though the latter is taken into account in cases of equal merit or sometimes in the case of lower grade jobs.

TABLE 16. — Promotions : seniority and ability.

RAILWAYS	Seniority	Ability	Appreciation of candidate's ability	Possible examination	Kind of examination
<i>Deutsche Bundesbahn</i>	50 %	50 %	...	no	...
<i>Austrian Rys.</i> .....	in cases of equal merit	chiefly	...	no	...
<i>S.N.C.B.</i> .....	in cases of equal merit	chiefly	by report; sometimes by interview	no	...
<i>S.N.C.V.</i> .....	in part	yes	by examination	yes	Administrative or technical
<i>Otraco.</i> .....	in part	yes	report every 6 months	no	...
<i>R.E.N.F.E.</i> .....	in part	yes	sometimes ability test	in certain cases	the professional diploma is taken into account
<i>S.N.C.F.</i> .....	1/4 of a point per annum	yes	grading table	yes	professionnal
<i>R.A.T.P.</i> .....	minimum required	solely	...	...	...
<i>Algerian Rys.</i> .....	25 %	yes	quota rating	yes	general and professional education
<i>Gafsa Ry.</i> .....	no	yes	ability graph	in certain cases	professionnal
<i>Tunisian Rys.</i> .....	no	yes	...	in certain cases	general and professional education
<i>West African Rys</i> ...	no	yes	...	in certain cases	...
<i>Madagascar Rys</i> ....	secondary	preponde- rant	...	yes	general and professional education
<i>Indochina Rys.</i> .....	in part	yes	way he works and aptitude for command	yes	general and professional education
<i>Italian Rys.</i> .....	for lower grade jobs	generally	...	sometimes	general and professional education
<i>North of Milan Ry.</i> ..		solely			
<i>Luxemburg Rys.</i> ....	no	yes	by examination	yes	...
<i>Netherlands Rys.</i> ....	yes	yes		yes	professional knowledge
<i>Portuguese Rys.</i> .....	secondary	yes	...	...	...
<i>Swiss Federal Rys.</i> ...	yes	yes	...	no	...
<i>Rhaetian Rys.</i> .....	secondary	yes	according to the work done	...	...
<i>Syrian Rys.</i> .....	yes	yes	merit, professional value	yes in certain cases	...
<i>Turkish Rys.</i> .....	secondary	in preference	...	yes	professional and general knowledge



## QUESTION 12.

*Is there a selection Board, and if so, does it recommend or make the appointment?      Who makes the final selection?*

REPLIES.

TABLE 17. — Selection Committee.

RAILWAYS	Proposal made by	Selection committee eventual composition	Intervening of personnel delegates	Final choice made by
<i>Deutsche Bundesbahn</i> ...	...	...	...	the managements
<i>Austrian Rys.</i> .....	...	Head of staff and Heads of dept. concerned	give opinion	...
<i>S.N.C.B.</i> .....	Staff dept.	Recruiting : Exam. committee; promotions : nominations's dept.	no; right of checking	Staff Manager or General Manager
<i>S.N.C.V.</i> .....	Executive committee	...	yes	Administration Board
<i>Otraco</i> .....	Management	...	...	Higher Management
<i>R.E.N.F.E.</i> .....	Special commissions drafting list and grading	no	...	Management
<i>S.N.C.F.</i> .....	Heads	Ability committee	yes	...
<i>R.A.T.P.</i> .....	Managements	Grading committee	yes	General Manager
<i>Algerian Rys.</i> .....	...	Grading committee and ability tables	...	...
<i>Gafsa Ry.</i> .....	...	...	...	Manager
<i>Tunisian Rys.</i> .....	Heads	Ability committee	yes	...
<i>West African Rys</i> ...	...	Promotion committee	yes	General Manager
<i>Madagascar Rys.</i> ...	...	Examination committee	...	Manager
<i>Indochina Rys.</i> .....	...	Ability committee	...	General Manager or Heads of dept.
<i>Cambodian Rys.</i> ....	...	...	...	...
<i>Italian Rys.</i> .....	Local committee	Central committee	...	Minister
<i>North of Milan Ry</i> .	...	...	...	General Manager
<i>Luxemburg Rys.</i> ....	...	no	...	...
<i>Netherlands Rys.</i> ....	Heads of dept.	no	...	Management
<i>Portuguese Rys.</i> .....	General Management	no	...	Administration Board
<i>Swiss Federal Rys.</i> ..	...	no	...	General Management or Regional Management
<i>Rhaetian Ry</i> .....	...	no	...	...
<i>Damas Ry.</i> .....	...	...	...	...
<i>Syrian Rys</i> .....	...	no	...	...
<i>Turkish Rys.</i> .....	Dept. concerned and Staff dept.	no	...	General Management

## QUESTION 13.

*Is there a training procedure? If so, does it provide pre- or post-appointment training after selection? Please give full particulars of your methods.*

## REPLIES.

## 1. Germany.

*Deutsche Bundesbahn.*

1) There is a service training scheme for officials with the object of increasing their knowledge of the existing instructions and bringing new ones to their notice. Two to six weeks courses in one of the Administration's schools. In the case of the higher grade jobs, there is one year's training in every department.

2) Service conferences take place according to circumstances and local conditions. Current questions are discussed.

## 2. Austria.

*Austrian Federal Railways.*

Training takes place in the schools after engagement (see group 2, point 5).

## 3. Belgium and Colony.

a) *Belgian National Railways Company*

Training is given in the case of section heads, engineers, commercial secretaries.

Training takes place after engagement during the probationary stage; this training includes written work (studies and reports on the probationer), it is carried out by means of correspondence courses organised by the professional schools; these courses prepare candidates for the entry examination at the end of their probationary period.

Courses (oral or correspondence), which the men can take if they so desire, are organised, in particular in the case of workmen studying to take a supervisory staff examination.

b) *National Light Railways.*

Training is in the hands of the immediate superiors and depends on the position at the time.

c) *Otraco.*

Supplementary and specialist training of the candidate may be stipulated in the case of the particular job for which he is applying.

In such a case, internal or external study courses may be necessary.

## 4. Spain.

*Red Nacional  
de los Ferrocarriles Españoles.*

In the case of officials, technical and supervisory staff, there does not appear to be any method other than practical training after engagement.

## 5. France and French Union.

a) *French National Railways Company.*

There are regional schools which can be attended by holders of diplomas : probationary stage which may be as long as 48 months.

Where there are such schools, they prepare candidates for the examinations or competitive examinations for promotion to higher grades.

b) *R.A.T.P.*

For supervisory staff and higher grades recruited from outside sources, a training period, usually in the different departments.

c) *Algerian Railways.*

Training takes place after engagement.

If the probationary period is not sufficient; disbanded.

d) *Gafsa Railway.*

For certain categories of supervisory jobs : exercises set by the head of the department.

e) *Tunisian Railways.*

For certain supervisory jobs (especially in connection with the safety) training courses tested by an examination before final engagement.

f) *French West African Railways.*

Training after engagement.

Sometimes a probationary period in the establishments of the S.N.C.F.

Evening classes are now being organised to increase their theoretical knowledge; correspondence courses preparing for the various competitive examinations for supervisory jobs.

a) *Madagascar Railways.*

Training takes place before engagement, usually on the S.N.C.F.

h) *Viet Nam Railways.*

Training after candidates are engaged.

There are training schools for the Operating, Permanent Way and Rolling Stock Departments.

i) *Cambodian Railways.*

No reply.

6. *Italy.*a) *State Railways.*

In the case of candidates for the higher administrative and technical jobs allocated on the results of competitive examinations, there is a 4 months course before engagement.

The main object is to be able to give each candidate the most rational posting.

b) *North of Milan Railway.*

No reply.

7. *Luxemburg.*

*Luxemburg National Railways Company.*

There is a probationary stage of one year in the different departments for candidates recruited by means of a competitive examination.

8. *Holland.*

*Netherlands Railways.*

New recruits in the higher grades undergo a training period for 66 weeks during which they pass through all the different departments of the undertaking.

9. *Portugal.*

*Portuguese Railways Company.*

There is no special training method.

10. *Switzerland.*a) *Swiss Federal Railways.*

In most cases, training is practical and completed by personal studies.

Engineers (university graduates) of the traction and shops departments have to undergo a practical training stage in the shops and on the locomotives.

b) *Rhaetian Railway.*

There is no special training method.

11. *Syria.*a) *Damas-Hamah Railway.*

No reply.

b) *Syrian State Railways.*

Training takes place after engagement.

12. *Turkey.*

*Turkish Railways.*

— Yes, especially for the traffic staff.

— A preliminary stage on an improver's course.

— The length of the course varies from 3 to 6 months.

— Training in other establishments, especially in the case of engineers.

Those who complete their studies (engineers) at the expense of the Administration, undertake to remain in the service of the Administration for an indefinite period.



## GROUP 4.

## Apprentices.

## QUESTION 1.

*Do apprentice training schools exist in any of your departments and to what trades are these apprentices guided?*

## REPLIES

From table 17 a) below it will be seen that a fairly large number of railways do not have any apprentice schools.

Others only have them on a very limited scale or have given them up.

In certain cases, apprenticeship takes place in the ordinary shops.

TABLE 17a). — Apprentice schools and training of apprentices.

RAILWAYS	Departments concerned	Jobs
<i>Deutsche Bundesbahn</i>	Apprenticeship shops	Tradesmen of various categories, fitter - boiler-maker - turner - mechanic - electrician.
<i>Austrian Rys.</i> .....	13 apprenticeship shops	Guard and book-keeper - blacksmith - electro-mechanic.
<i>S.N.C.B.</i> .....	Operating, Rolling Stock and Stores, Electricity and Signalling:	
<i>S.N.C.V.</i> .....	No school	...
<i>Otraco.</i> .....	No school	...
<i>R.E.N.F.E.</i> .....	15 schools : Rolling stock, Permanent Way, Electricity	Fitter, erector - carpenter - cabinetmaker, pattern-maker - turner, miller, boilermaker, moulder, blacksmith, welder, oil winder, clock-maker, mechanic, electrician.
<i>S.N.C.F.</i> .....	Depots, large shops, electrical departments	Fitter, turner, boilermaker, mechanic, electrician.
<i>R.A.T.P.</i> .....	...	Fitter, turner, boilermaker, blacksmith, electrician.
<i>Algerian Rys.</i> .....	5 schools attached to the Traction Department	Turner, boilermaker, motorman, fitter-electrician.
<i>Gafsa Ry.</i> .....	Apprenticeship given up	...
<i>Tunisian Rys.</i> .....	School provisionally closed down	...
<i>West African Rys.</i> .....	Shops and depots of the Rolling Stock and Traction Departments	...
<i>Madagascar Rys.</i> ...	No schools as yet	...
<i>Indochina Rys.</i> .....	Rolling Stock and Traction Departments	Workmen of various categories : shops and sheds.
<i>Cambodian Rys.</i> ....	To be set up in the Rolling Department	Fitter, erector, turner, boilermaker, miller, blacksmith, electrician, joiner, patternmaker, moulder.
<i>Italian Rys.</i> .....	Large repair shops	Fitter, electrician, boilermaker, blacksmith, joiner, upholsterer, varnisher.
<i>North of Milan Ry</i> .	No school	...
<i>Luxemburg Rys.</i> ....	An apprenticeship centre	Fitter, turner, boilermaker, operating department pupils.
<i>Netherlands Rys.</i> ....	Two shops	Special trades.
<i>Portuguese Rys.</i> .....	In the shops	Specialist workmen.
<i>Swiss Federal Rys.</i> ..	No school	...
<i>Rhaetian Ry</i> .....	No school	...
<i>Damas Ry.</i> .....	No school	...
<i>Syrian Rys</i> .....	No school	Service apprentices : stations and trains
<i>Turkish Rys.</i> .....	No school	Trials did not give satisfactory results.

QUESTION 2.

## REPLIES.

*What are the conditions for admission? Do children of employees receive preferential treatment?*

Conditions under which apprentices are admitted are summed up in the table below (Table 18).

TABLE 18. — Apprenticeship — Conditions governing admission.

[illegible]

Priority is given to the sons of employees on the Deutsche Bundesbahn, Austrian Federal Railways, Belgian National Railways, Belgian National Light Railways, R.E.N.F.E., Gafsa, Madagascar, Viet Nam, Italian, Netherlands (in case of equal merit), Portuguese (likewise), Turkish, and Syrian State Railways (sons of pensioned or deceased employees), whereas the French National Railways, R.A.T.P., Algerian, French West African and Luxemburg Railways increase the number of marks gained by the candidate for this reason by varying amounts, or sometimes extend this benefit to other categories or for other reasons (family situation, degree of education, war

orphans, state pupils, children of large families, employees' grandsons).

### QUESTION 3.

*How is the education of the apprentices organised? Day or night classes?*

### REPLIES.

It will be noted that no railway has organised evening classes (Table 19).

Only two Administrations (Belgian National Railways and French National Railways) have organised correspondence courses in conjunction with the courses in the schools.

TABLE 19. — Organisation of the schooling.

RAILWAYS	No school	Daytime	Evening	Correspondence courses	General education and profess. training		Practical training	Advanced courses	Physical training
					Railway school	Private school			
<i>Deutsche Bundesbahn</i>	...	×	...	...	×	×	...	×	...
<i>Austrian Rys.</i>	...	×	...	...	×	×	...	...	...
<i>S.N.C.B.</i>	...	×	...	×	×	...	×	...	×
<i>S.N.C.V.</i>	...	×	...	...	...	...	×	...	...
<i>Otraco.</i>	×	...	...	...	...	...	...	...	...
<i>R.E.N.F.E.</i>	...	×	...	...	×	...	×	...	...
<i>S.N.C.F.</i>	...	×	...	×	×	...	×	×	...
<i>R.A.T.P.</i>	...	×	...	...	×	...	×	...	×
<i>Algerian Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Gafsa Ry.</i>	×	...	...	...	...	...	...	...	...
<i>Tunisian Rys.</i>	×	...	...	...	...	...	...	...	...
<i>West African Rys</i>	...	×	...	...	×	...	×	...	...
<i>Madagascar Rys</i>	×	...	...	...	...	...	...	...	...
<i>Indochina Rys.</i>	...	×	...	...	×	...	×	...	×
<i>Cambodian Rys.</i>	...	×	...	...	×	...	×	...	×
<i>Italian Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Luxemburg Rys.</i>	...	×	...	...	...	×	×	...	...
<i>Netherlands Rys.</i>	...	×	...	...	...	...	...	...	...
<i>Portuguese Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Swiss Federal Rys.</i>	...	×	...	...	×	...	×	...	...
<i>Rhaetian Ry.</i>	...	×	...	...	×	...	×	...	...
<i>Damas Ry.</i>	×	...	...	...	...	...	...	...	...
<i>Syrian Rys.</i>	...	×	...	...	...	...	×	...	...
<i>Turkish Rys.</i>	...	×	...	...	...	...	×	...	...



On nearly all the railways the courses are given in the railway schools.

The Deutsche Bundesbahn, Austrian Federal and Luxembourg Railways also make use of private schools.

Finally, on nearly all railways the schooling is completed by practical experience.

#### QUESTION 4.

*What is the duration of apprenticeship and what are the arrangements for engaging them? (contract — wages, etc.)*

#### REPLIES.

Table 20 below shows that the appren-

ticeship period is from 9 months to 5 years, except on the Belgian National Light Railways where it is variable and indeterminate.

Nearly everywhere, apprenticeship is based on a contract and wages are paid during nearly the whole period.

#### QUESTION 5.

*Is there an official appointed in your organisation to supervise the selection and training of apprentices?*

#### REPLIES.

An affirmative reply was given by the Deutsche Bundesbahn, Austrian Federal

TABLE 20. — Length of apprenticeship — Conditions of engagement.

RAILWAYS	Period	Contract of apprenticeship	Wages	Holidays with pay	Free meals	Lodging
<i>Deutsche Bundesbahn</i>	3 to 3 1/2 years	×	×	...	...	...
<i>Austrian Rys.</i> .....	3 to 3 1/2 years	×	graduated indemnity	...	...	...
<i>S.N.C.B.</i> .....	3 years	×	graduated	...	...	...
<i>S.N.C.V.</i> .....	variable	×	×	...	...	...
<i>Otraco</i> .....	...	...	...	...	...	...
<i>R.E.N.F.E.</i> .....	3 to 4 years	...	graduated	apprentices are treated like permanent staff		
<i>S.N.C.F.</i> .....	3 years	×	25 to 75% according	...	...	...
<i>R.A.T.P.</i> .....	3 years	×	to ability grading and seniority	×	in part	...
<i>Algerian Rys.</i> .....	3 years	×	graduated	...	...	...
<i>Gafsa Ry.</i> .....	...	...	...	...	...	...
<i>Tunisian Rys.</i> .....	...	...	...	...	...	...
<i>West African Rys.</i> ..	3 years	×	graduated + bonus	...	×	×
<i>Madagascar Rys.</i> ...	1 to 3 years	...	graduated	...	...	...
<i>Indochina Rys.</i> .....	3 years	×	graduated + bonus	...	...	...
<i>Cambodian Rys.</i> ....	3 years	×	graduated + bonus	...	...	...
<i>Italian Rys.</i> .....	2 years	...	compensation for profess. expenses	...	...	...
<i>Luxemburg Rys.</i> ....	3 years	×	graduated	...	...	...
<i>Netherlands Rys.</i> ....	2 years	×	small	...	...	...
<i>Portuguese Rys.</i> .....	3 years	...	×	...	...	...
<i>Swiss Federal Rys.</i> ..	9 mon. to 2 years	...	graduated	...	...	...
<i>Rhaetian Ry</i> .....	1 to 2 years	×	...	...	...	...
<i>Syrian Rys</i> .....	5 years	×	1/3 to 4/5 of a workman's wage	...	...	...
<i>Damas Ry.</i> .....	—	—				
<i>Turkish Rys.</i> .....	—	—				

Railways, S.N.C.B., R.E.N.F.E., S.N.C.F., R.A.T.P., Algerian, French West African, Viet Nam, Cambodian, Italian, Luxemburg, Portuguese, Swiss Federal and Turkish Railways.

A negative reply was given by the Belgian National Light Railways Company, Gafsa, Tunisian, Madagascar, Netherlands, Rhaetian, Damas-Hamah and Syrian State Railways.

The S.N.C.B. allow technical and administrative officials as well as supervisory staff to act as professors. So do the R.A.T.P.

The Belgian Light Railways Co. only employ supervisory staff as professors; the S.N.C.F. and Madagascar Railways make use of technical officials and supervisory staff.

On the Italian Railways, this job is given to the shop foremen, and to specialist professors on the Netherlands Railways.

The Swiss Federal Railways make use of technical and administrative officials, the Rhaetian Railway, only of administrative officials, and finally the Turkish Railways, members of the supervisory staff.

#### QUESTION 6.

*Do apprentices have absolute priority in being taken into the permanent staff on completion of their training?*

#### REPLIES.

Apprentices have a priority :

*By right :* on the S.N.C.B., National Light Railways Co., S.N.C.F., R.A.T.P., Algerian, French West African, Vietnam, Cambodian, Luxemburg, Netherlands, Swiss Federal, Rhaetian and Turkish Railways.

*In fact :* on the Deutsche Bundesbahn and Austrian Federal Railways.

*Relative :* on the Madagascar, Portuguese, and Syrian State Railways.

There is no priority of any sort on the Italian Railways.

On the R.E.N.F.E. apprentices are already considered to be part of the permanent staff.

#### QUESTION 7.

*Does their education aim at moulding them into tradesmen capable of tackling successfully, after a few years of experience the examination set for supervisory grades?*

#### REPLIES.

Table 21 hereafter shows that nearly all the railways, who have organised apprentice schools, have done so in order to get a nucleus of supervisory staff.

Such jobs are obtained after an examination or again after a certain number of years service.

Naturally, these apprentices before embarking on an executive career must have trained as proper tradesmen.

#### GROUP 5.

**Part played by the medical services in the recruiting of staff.**

#### QUESTION 1.

*What part is played by the medical service during your recruiting? Is its responsibility limited to the time of acceptance into service of the candidates? Or does the Medical Service play its part each time an individual is promoted? Is it applied systematically and regularly in order to examine physical aptitudes of certain individuals? Of whom and at which intervals?*

#### REPLIES.

Table 22 hereafter shows the frequency and periodicity of medical inspections.

All the railways require a medical examination to be passed on engagement both in the case of permanent and temporary staff.

TABLE 21. — Training of apprentices for executive jobs.

RAILWAYS	Training considered as forming a nucleus of executive staff	Access to executive grades by means of an examination
<i>Deutsche Bundesbahn</i> .....	...	yes
<i>Austrian Rys.</i> .....	...	yes
<i>S.N.C.B.</i> .....	yes	yes
<i>S.N.C.V.</i> .....	...	yes
<i>Otraco.</i> .....	there is no apprenticeship school	...
<i>R.E.N.F.E.</i> .....	yes	...
<i>S.N.C.F.</i> .....	yes, in the case of able employees who have access to the advanced apprenticeship courses	yes
<i>R.A.T.P.</i> .....	yes	yes
<i>Algerian Rys.</i> .....	yes	...
<i>Gafsa Ry.</i> .....	yes	...
<i>Tunisian Rys.</i> .....	apprenticeship school provisionally closed	...
<i>West African Rys.</i> .....	yes	...
<i>Madagascar Rys.</i> .....	there is no apprenticeship school	...
<i>Indochina Rys.</i> .....	yes	yes
<i>Cambodian Rys.</i> .....	yes	...
<i>Italian Rys.</i> .....	yes	yes
<i>Luxemburg Rys.</i> .....	yes	...
<i>Netherlands Rys.</i> .....	...	...
<i>Portuguese Rys.</i> .....	yes	...
<i>Swiss Federal Rys.</i> ..	there is no apprenticeship for tradesmen	...
<i>Rhaetian Ry.</i> .....	there is no apprenticeship school	...
<i>Damas Ry.</i> .....	there is no apprenticeship school	...
<i>Syrian Rys.</i> .....	...	...
<i>Turkish Rys.</i> .....	yes, after 9 years service	...

A certain number of railways stipulate a further medical examination on passing from the temporary staff to the permanent staff or on promotion to the higher grade jobs.

The majority of administrations also prescribe periodical examinations at varying intervals, either in the case of employees whose jobs concern the safety, drivers of buses or motormen, or even for all employees.

Psychotechnical examinations in addition to the medical examination are held on the S.N.C.B. (in the case of partly disabled men allocated to light duties), R.A.T.P. (always) and Turkish Railways (when necessary).

## QUESTION 2.

*Does the decision as to the admission or rejection of candidates rest with the Medical Service or with the Executive?*

## REPLIES.

The decision lies with the Medical Service on the following railways : Austrian Federal, S.N.C.B., Tunisian (the Management may however authorise exceptions), Italian, North of Milan, Portuguese, Swiss Federal (the administration decides in doubtful cases) and Turkish Railways.

On the other hand, the Administration decides (on the advice of the Medical Ser-



TABLE 22. — Part played by the medical services.

RAILWAYS	Examination on admission to		Examination on promotion to another grade		Periodical examinations			After an illness or accident
	Perma- nent staff	Tempo- rary staff	T— Grade P— Grade	Certain higher grade jobs	Safety employees	Drivers, motormen	All employees	
<i>Deutsche Bundesbahn</i>	yes	yes	...	...	yes : 5 years	2 years	less than 21 years	...
<i>Austrian Rys.</i> .....	yes	yes	...	...	...	...	5 years up to 44 years old, 3 years from 45 to 60, 2 years after 60	yes
<i>S.N.C.B.</i> .....	yes	yes	yes	yes	...	by probing; for drivers of pass. vehicles : com- plete exam. 5 years, check every year	...	yes
<i>S.N.C.V.</i> .....	yes	yes	...	...	...	...	...	yes
<i>Otraco</i> .....	yes	...	...	...	...	...	...	...
<i>R.E.N.F.E.</i> .....	yes	yes	...	yes	...	...	...	...
<i>S.N.C.F.</i> .....	yes	yes	yes	...	5 to 10 years up to 40 years, 3 to 5 years after 40	...	...	...
<i>R.A.T.P.</i> .....	yes	yes	yes	...	...	3, 2, 1 year ac- cording to age	1 year, op- tional	...
<i>Algerian Rys.</i> .....	yes	...	...	...	yes	...	yes	...
<i>Gafsa Ry.</i> .....	yes	yes	yes	...	5 to 10 years up to 40 years, 3 to 5 years after 40 years	...	probing	...
<i>Tunisian Rys.</i> .....	yes	yes	yes	...	yes	yes	...	...
<i>West African Rys</i> ...	yes	yes	...	...	5 to 7 years up to 40 years, 3 to 5 years after 40 years	...	...	...
<i>Madagascar Rys</i> ....	yes	yes	...	...	...	yes	...	...
<i>Indochina Rys.</i> .....	yes	yes	...	...	2 years	...	...	...
<i>Cambodian Rys.</i> ....	yes	yes	...	...	5 years	5 years	...	...
					3 years	3 years	...	...
<i>Italian Rys.</i> .....	yes	yes	...	yes	2 years	2 years	...	...
					yes	...	exposed to prof. diseases	yes
<i>North of Milan Ry.</i> ..	yes	yes	...	...	...	yes	...	...
<i>Luxemburg Rys.</i> ....	yes	yes	yes	yes	yes	...	...	...
<i>Netherlands Rys.</i> ....	yes	yes	...	yes	...	...	5 years	...
<i>Portuguese Rys.</i> .....	yes	yes	...	yes	5 years	5 years	...	...
<i>Swiss Federal Rys.</i> ..	yes	yes	yes	yes	considered	3 years	...	...
<i>Rhaetian Ry.</i> .....	yes	yes	...	...	5 years up to 50 years old, 3 years after 50 years	5 years up to 50 years old, 3 years after 50 years	...	...
<i>Damas Ry.</i> .....	yes	yes	yes	...	...	...	...	...
<i>Syrian Rys.</i> .....	yes	yes	yes	...	...	...	...	...
<i>Turkish Rys.</i> .....	yes	yes	...	...	1 year	1 an	according to the case	...

vice or in consultation with it) on the Deutsche Bundesbahn, National Light Railways, Otraco, R. E. N. F. E., S. N. C. F., R.A.T.P., Algerian, Gafsa, French West African, Madagascar, Vietnam, Cambodian, Luxemburg, Netherlands, Rhaetian, Damas-Hamah and Syrian State Railways.

### QUESTION 3.

*Have you set up conditions which decide the physical requirements necessary for your various duties and above all, the physical debilities and ailments likely to debar a candidate?*

### REPLIES.

Nearly all the railways who replied to our questionnaire have made regulations of this kind.

The exceptions are :

National Light Railways Co., Otraco, Swiss Federal and Rhaetian Railways.

The R.E.N.F.E. has such regulations under consideration

On the Italian Railways, there are regulations but no lists of illnesses or disabilities on account of which candidates can be rejected.

On the Netherlands Railways, the Medical Service makes such decisions on its own responsibility.

### QUESTION 4.

*What constitutes the medical examination?*

- a) for candidates to permanent employment?
- b) for candidates to temporary employment?

*Does it entail, in any event, a detailed check (examination of the sensory system, of reflexes, of the heart and lungs, of the sharpness of sight, etc.)?*

*If the medical examination is only curatory for certain forms of employment, what is the extent of such examination and in respect of what types of employment?*

### REPLIES.

All the Administrations advised us that a thorough medical examination was carried out before admission to the permanent staff.

In the case of applicants for temporary jobs, no medical examination is required on the Madagascar, Vietnam, Cambodian and Netherlands Railways.

The examination is equally thorough in the case of temporary staff on the R.E.N.F.E., Gafsa, French West African, Italian, North of Milan, Luxemburg, Portuguese and Syrian State Railways.

It is summary for this category of staff or much less thorough on the Deutsche Bundesbahn, S.N.C.B., S.N.C.F., R.A.T.P., Algerian, Tunisian, Swiss Federal and Turkish Railways.

The S.N.C.B. requires employees to have their eyes tested in the case of certain jobs (machinists, machinist-instructors, semi-valids, partly disabled men).

On the Madagascar Railways, a special medical examination is carried out in the case of drivers.

A general medical overhaul, eye test and hearing test are prescribed periodically on the Luxemburg Railways.

The Turkish Railways require a quarterly medical examination in the case of workmen doing heavy work.

### QUESTION 5.

*Is the medical recruiting examination carried out by a full time medical officer of the Administration? If not, by whom?*

### REPLIES.

The medical examination on engagement is made by full time railway doctors on the Deutsche Bundesbahn, Austrian Federal, S.N.C.F., R.E.N.F.E., S.N.C.F. (though not necessarily), French West African, Madagascar (for lower grades only), Vietnam, Cambodian, Italian, North of Milan, Netherlands, Portuguese, Syrian State and





On the Austrian Federal and Algerian Railways, other specialists are called in in doubtful cases.

GROUP 6.

Labour fluctuations.

QUESTION 1.

What is the annual personnel replacement rate of the undertaking under present operating conditions :

- a) for wage grades?
- b) for the rest of the staff?

If possible, give variations in the rates over the last 25 years.

REPLIES.

Table 23 above gives the data asked for, in general for the staff as a whole. Very little information was supplied for the last 25 years.

The Deutsche Bundesbahn was not able to give such data owing to the dividing up of Germany.

At the present time the following countries have a very low rate of replacement, Austria (1.3 %) which is being seen already in the lack of any recruiting of labour between 1924 and 1934 and from 1938 to 1949, and a very restricted intake between 1935 and 1937, and the Cambodian Railways (1.7 %).

For every 10 employees leaving, the S.N.C.F. recruited in 1938 and 1939 1.2 men, from 1940 to 1944, 8.6 men, in 1945, 23 men (greatly increased intake after the liberation), from 1946 to 1948, 5.7 men, in 1949 and 1950, 1.5 and in 1951 and 1952, 3.3 men.

Otraco, the Damas-Hamah and Turkish Railways did not reply or were not able to reply to this question.

QUESTION 2.

What changes have been made in your establishment during the last 25 years?

REPLIES.

The table 24 below gives the average labour force in round figures at 5-yearly intervals for the last 25 years.

TABLE 24. — Changes in number of personnel.

RAILWAYS	Arithmetical average of the labour employed during the years				
	1928 to 1932	1933 to 1937	1938 to 1942	1943 to 1947	1948 to 1952
Deutsche Bundesbahn . . . . .	...	...	...	529 806	541 575
Austrian Rys. . . . .	81 195	55 337	166 878	103 466	78 973
S.N.C.B. . . . .	100 380	85 930	83 186	95 372	88 548
S.N.C.V. . . . .	...	9 313	9 945	13 106	10 805
R.E.N.F.E. . . . .	...	...	109 155	119 580	129 370
S.N.C.F. . . . .	492 260	456 520	499 700	489 266	443 700
R.A.T.P. . . . .	39 171	37 675	29 952	26 503	33 726
Algerian Ry. . . . .	19 510	17 142	17 564	18 230	15 727
Gafsa Rys. . . . .	1 850	1 330	1 540	1 470	2 205
Tunisian Rys. . . . .	5 468	5 032	6 004	6 101	5 522
Vietnam Rys. . . . .	6 620	8 850	19 500	17 600	5 133
Italian Rys. . . . .	157 134	135 246	151 891	199 026	177 285
North of Milan Rys. . . . .	2 596	1 970	1 838	2 420	2 208
Swiss Federal Rys. . . . .	...	29 670	30 449	34 577	38 382

Very few railways gave us the information required.

It will be noted however that all the railways having a large staff have tended to reduce it.

This tendency has, however, not been consistent nor continuous; it is sometimes interrupted by periods at which the labour force has been increased for various reasons : changes in working hours, 5-day week in certain countries, effects of war or political upheavals (Anschluss in Austria for example).

It can however be stated that all other things being equal, there has been a regular and continuous reduction in the labour force.

This reduction is particularly definite on the Austrian Federal Railways (where however no attention should be paid to the figures for the years 1936 to 1942, which were affected by the Anschluss and the war), on the S.N.C.B., S.N.C.F. and Italian Railways.

Exceptions to the rule are the R.E.N.F.E. (30 % increase since 1941) and Swiss Federal Railways which have remained practically static since 1927 before which there were periods of reductions and increases in staff.

### QUESTION 3.

*What is the retiring age :*

- a) *obligatory (age limit) ?*
- b) *by request (right of the individual) ?*
- c) *by premature unfitness (average age) (illness or injuries) ?*

### REPLIES.

Table 25 hereafter sums up the chief data. To this we must add certain details which affect a considerable number of railways.

It is strange to see that the average age of premature retirement due to ill health is higher in the case of female than male

employees (Deutsche Bundesbahn : 56 and 60 years).

On the other hand, certain railways fix a lower age limit for retirement for female labour (National Light Railways Co. : 60 compared with 65 for men).

Several railways grant a reduced pension in the case of premature retirement due to ill-health when the employee in question has not been employed long enough to qualify for the normal pension, or if his disability is more than 66 %, he gets the ordinary national health service pension.

On the Algerian Railways there is a proportionate pension when the employee leaves *at his own request* after 15 years service.

### QUESTION 4.

*Are you in a position to furnish a chart showing composition of your permanent staff in age groups (from 20 to 65 years of age or more, according to the obligatory retiring age) ?*

### REPLIES.

Table 26 hereafter is very enlightening.

Though it is only normal to find few employees of less than 20 (the section only covers two years), it is surprising to see that there are so few in the 21 to 25 age group.

Only the Indochina Railways are an exception, with 15.6 % and to a lesser degree the Deutsche Bundesbahn (8.6 %).

But in the case of the Deutsche Bundesbahn, where there was a complete upheaval as a result of the war followed by a thorough reorganisation, they reported their intention of recruiting young employees.

This small percentage in the 20 to 25 age group means that there has obviously been a very serious reduction in recruitment during the last few years.

This fact is confirmed, though less pronounced, in the following age groups : 26 to 30 and 31 to 35.

Many railways have the greatest proportion of staff in the 36 to 40, 41 to 45 and 46 to 50 age groups.

Attention must also be called to the fact

that certain maximum percentages are found in the 51 to 55 age group, and even in the case of the Netherlands Railways in the 56 to 60 age group.

TABLE 25. — Age of retirement.

RAILWAYS	Obligatory		On request		Prematurely for ill health (average age)	Special remarks
	Travelling staff	Sedentary staff	Travelling staff	Sedentary staff		
<i>Deutsche Bundesbahn</i>	65		62		50	...
<i>Austrian Rys.</i> .....	65 (in fact)		35 years	service	at least 5 years service	exceptions in the case of accidents at work, blindness, insanity
<i>S.N.C.B.</i> .....	65		55	60	56 years 7 months	at least 5 years service are required
<i>S.N.C.V.</i> .....	65		60		57 1/2	...
<i>Otraco</i> .....	45 years with 20 years service		45 years with 20 years service		any age	6 years service in the case of ill health
<i>R.E.N.F.E.</i> .....	60 64 68		55	60 and 25 years service	53 (15 years service minimum)	...
<i>S.N.C.F.</i> .....	60 (58 years 3 m.)		50	55 and 25 years service	15 years service	age limit fixed by the General Mana- gement
<i>R.A.T.P.</i> .....	55	63 years	50 55 60 with 30 or 25 years service		no age limit but must have had 25 or 30 years service	proportional pen- sion if insufficient years in service
<i>Algerian Rys.</i> .....	50	55	15 years service (pro- portional pension)		15 years service	...
<i>Gafsa Ry.</i> .....	60	65	50	55	48 years 7 months	...
<i>Tunisian Rys.</i> .....	50	55	...	...	44 years	...
<i>West African Rys</i> ...	55	58	15 years	service	15 years service	additional pension for each child to support
<i>Madagascar Rys.</i> ...	55	58	...	...	...	ditto
<i>Indochina Rys.</i> .....	55	60	25 years	service	...	...
<i>Cambodian Rys.</i> ...	55	60	30 years	service	no conditions	...
<i>Italian Rys.</i> .....	58	66	55	60	50 years	...
<i>North of Milan Ry</i> .	55	60	...	...	...	...
<i>Luxemburg Rys.</i> ...	60	65	55	60	50 years	...
<i>Netherlands Rys.</i> ...	65 (63)		55	60	...	...
<i>Portuguese Rys.</i> .....	70	...	55	60	53 years	...
<i>Swiss Federal Rys.</i> ..	65	...	60		61 years	...
<i>Rhaetian Ry</i> .....	65	...	65		65 years	...
<i>Damas Ry.</i> .....	60	...	if service require- ments permit		...	...
<i>Syrian Rys</i> .....	60	...	...	...	...	...
<i>Turkish Rys.</i> .....	65	...	55		15 years service	...



TABLE 26. — Charts showing composition of permanent staff in age groups.

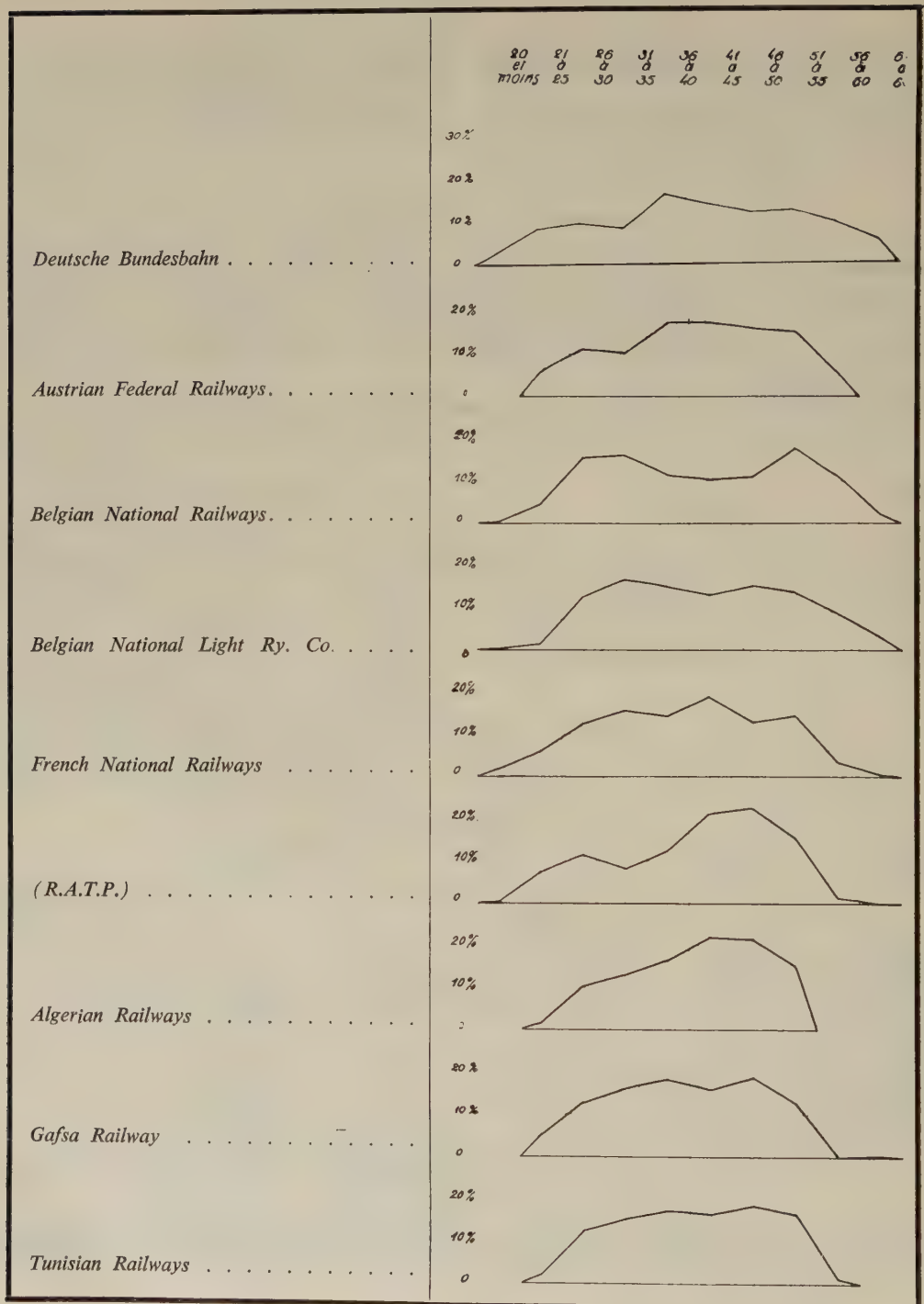
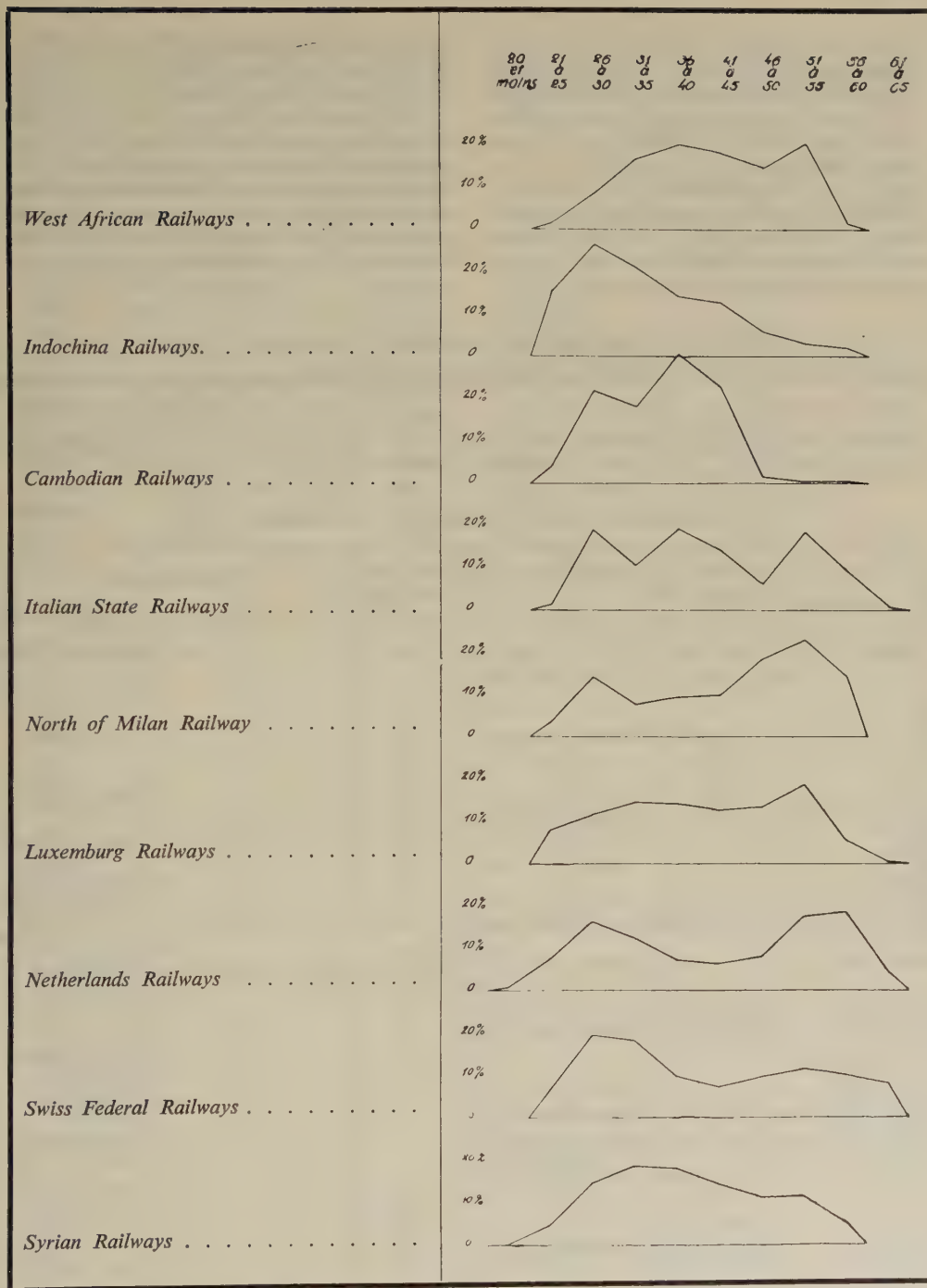


TABLE 26. — (Continued).



## QUESTION 5.

*If, during the last 25 years, you have been compelled to suspend all recruiting for a certain period, what inconveniences were experienced? How and when were these felt?*

## REPLIES.

The data supplied, summed up in table 27 below, show that nearly all the railways have experienced periods of mass retirements or cessation of recruitment.

The National Light Railways have retired all their oldest employees in order to avoid future inconveniences.

The Netherlands Railways recruited very little labour between 1925 and 1938, and report the drawback that recruitment in the future means that at the present young officials will have to be promoted to very responsible jobs, whereas the young officials following them will have no prospects of promotion.

TABLE 27. — Drawbacks due to suspension of recruitment of labour.

RAILWAYS	Increase in the average age and wage	Increase in social charges	Promotion : irregular and unrhyth-mical	Difficulty in filling the higher posts	Insufficient profes-sional training	Social draw-backs : retire-ment unem-ployment	Periods of retirements Period when the drawbacks become manifest
<i>Deutsche Bundesbahn</i>	×	...	×	...	...	...	1922/28; 1930/32; 1948/51
<i>Austrian Rys.</i> .....	×	×	...	×	×	...	1924/37; manifest 1946 and after
<i>S.N.C.B.</i> .....	×	...	×	×	...	...	...
<i>S.N.C.V.</i> .....	...	...	...	...	...	...	since 1945
<i>Otraco.</i> .....	no reply	...	...	...	...	...	...
<i>R.E.N.F.E.</i> .....	...	...	...	...	...	...	1936/39 (war)
<i>S.N.C.F.</i> .....	×	...	×	...	...	...	...
<i>R.A.T.P.</i> .....	...	...	...	...	...	...	1940 to 1945
<i>Algerian Rys.</i> .....	...	...	...	...	×	...	...
<i>Gafsa Ry.</i> .....	...	...	...	...	...	...	1945 and 1946
<i>Tunisian Rys.</i> .....	...	×	×	×	...	...	1932/36; 1947/53.
<i>West African Rys</i> ...	impossible to supply these data, only resumed operation in 1947						...
<i>Madagascar Rys</i> ...	no drawbacks; only auxiliary staff recruited between 1935-1950						1935/50
<i>Indochina Rys.</i> .....	...	...	...	...	...	×	...
<i>Cambodian Rys.</i> ...	recruitment	never	suspended	...	...	...	...
<i>Italian Rys.</i> .....	...	...	...	...	...	...	1933; 1943/46
<i>North of Milan Ry.</i> ..	...	...	...	...	...	...	1946/1952
<i>Luxemburg Rys.</i> ....	...	...	...	×	...	...	1930/39
<i>Netherlands Rys.</i> ....	...	...	×	×	...	...	1925/38
<i>Portuguese Rys.</i> .....	...	...	×	...	...	...	1949/1952
<i>Swiss Federal Rys.</i> ...	...	...	×	×	...	...	1925/28; 1931/37.
<i>Rhaetian Ry.</i> .....	recruitment	never	suspended	...	...	...	...
<i>Damas Ry.</i> .....	no reply	...	...	...	...	...	...
<i>Syrian Rys.</i> .....	×	...	...	...	...	...	...
<i>Turkish Rys.</i> .....	the question	does not	arise	...	...	...	...



The Swiss Federal Railways have made good labour shortages at certain periods by engaging more female staff and auxiliary staff.

Apart from these particular cases, most of the Administrations concerned report that the chief drawback is the increase in the average age and average wage as well as social charges, the sudden changes and lack of rhythm in promotion, and the difficulty of filling the higher posts.

The methods (or lack of method) in recruiting are leading to the state of affairs in which the reins of office are in the hands of very young officials who will not have had the time to acquire sufficient training and experience.

These will be followed by other young

officials who will be discouraged because all the important jobs are held by men not much older than themselves.

#### QUESTION 6.

*Are all employees resigning the service interviewed in order to ascertain their motives for leaving the organisation?*

#### REPLIES.

Table 28 below does not call for any comment.

Most railways do not worry about the reasons which have led some of their staff to leave.

The information obtained from the rare cases in which the employees are questioned, does not give any useful results.

TABLE 28. — Staff leaving of their own accord.

RAILWAYS	Are they questioned?	Do they give any reasons for leaving? What reasons?
<i>Deutsche Bundesbahn</i> . . . . .	no	usually, the employees explain their reasons for leaving without being asked
<i>Austrian Rys.</i> . . . .	no	...
<i>S.N.C.B.</i> . . . . .	no	...
<i>S.N.C.V.</i> . . . . .	yes	usually; often for a better paid post
<i>Otraco.</i> . . . .	no	...
<i>R.E.N.F.E.</i> . . . . .	yes	sometimes; it is intended to make this the general practice
<i>S.N.C.F.</i> . . . . .	no	...
<i>R.A.T.P.</i> . . . . .	yes	yes, in writing
<i>Algerian Rys.</i> . . . .	no	...
<i>Gafsa Ry.</i> . . . .	no	we endeavour to find out the reason
<i>Tunisian Rys.</i> . . . .	no	we endeavour to find out the reason
<i>West African Rys.</i> . . . .	yes	yes
<i>Madagascar Rys.</i> . . . .	yes	yes
<i>Indochina Rys.</i> . . . .	no	...
<i>Cambodian Rys.</i> . . . .	yes	yes in the case of valued men
<i>Italian Rys.</i> . . . .	no	...
<i>North of Milan Ry.</i> . . . .	no	...
<i>Luxemburg Rys.</i> . . . .	no	...
<i>Netherlands Rys.</i> . . . .	no	except in the case of female staff, who are questioned by the social workers
<i>Portuguese Rys.</i> . . . .	no	employees usually give the reason why they are leaving
<i>Swiss Federal Rys.</i> . . . .	no	...
<i>Rhaetian Ry.</i> . . . .	no	...
<i>Damas Ry.</i> . . . .	yes	...
<i>Syrian Rys.</i> . . . .	no	...
<i>Turkish Rys.</i> . . . .	no	...

## QUESTION 7.

*Is the labour turnover insofar as it may reveal :*

- a) *unrest in the working force?*
- b) *inefficiency :*
  - *due to unsatisfactory recruitment methods?*
  - *due to unsatisfactory industrial relations?*
  - *in working, due to lack of training or experience in the job?*
  - *caused by lack of interest?*
- c) *economic loss by :*
  - *having to recruit and train in new employees?*
  - *inefficient working?*

- c) Necessity to take new recruits in order to give employees time to prepare for their examinations.

## 3. Belgium and Colony.

a) *Belgian National Railways.*

- a) Any uneasiness is dealt with by the Paritary Commission.
- b), c) The present position in the labour market enables all service requirements to be met.

b) *National Light Railways Co.*

- a), b), c) No.

The evolution of the labour force depends on the volume of traffic.

c) *Otraco.*

## REPLIES.

## 1. Germany.

*Deutsche Bundesbahn.*

Individual contacts as well as contacts with the staff representatives give a very good idea of the atmosphere.

The sequels of the war (housing and food) have been to increase labour requirements.

The obligation to employ a certain percentage of disabled persons has also led to modifications in the labour estimates.

## 2. Austria.

*Austrian Federal Railways.*

- a) To avoid this uneasiness, certain measures likely in themselves to increase productivity have been given up (abolishing the 5 day's week, length of service in terms of the jobs).
- b) — After the war, recruiting of inexperienced men and lack of means to train them.
- Lack of general and professional education in the young generation.

- a) Yes.
- b) — Yes.
- Nothing.
- Nothing.
- Nothing.
- c) — Nothing.
- Nothing.

## 4. Spain.

*R.E.N.F.E.*

The evolution of the labour position is not due to any troubles with the staff.

## 5. France and French Union.

a) *French National Railways.*

The labour reductions of recent years have been due to :

- technical progress;
- organic reorganisation;
- reduction in costs (competition).

The S.N.C.F. has had to apply these measures to its staff which has understood the necessity for such measures; the general output has increased.

In return the S.N.C.F. has endeavoured to give its employees all the financial and social advantages possible in view of the general economic situation of the country.

— Reductions in labour have never taken place under conditions not authorised in the statutes.

— Recruiting and training methods are satisfactory.

b) *R.A.T.P.*

The present labour position meets all service requirements.

c) *Algerian Railways.*

So far there has been no reason to examine the question from this angle.

d) *Gafsa Railway.*

a) Yes.

b) A little.

c) Above all.

e) *Tunisian Railways.*

The problem has not arisen so far.

f) *Madagascar Railways.*

a) Yes.

b) Nothing.

c) Yes, partly.

g) *Viet Nam Railways.*

a), b) Yes.

h) *Cambodian Railways.*

The only recruiting troubles are to find staff of the proper quality :

— Agricultural country which is not yet industrialised.

— Efforts are being made by the Government to remedy this.

— A great many manoeuvres.

## 6. Italy.

a) *State Railways.*

a) The Italian Railways are doing their best to avoid any staff trouble by social measures, but are endeavouring to reduce their staff by limiting new entries.

b) No.

c) Small owing to the obligation to recruit disabled persons.

b) *North of Milan Railways.*

No reply.

## 7. Luxemburg.

*Luxemburg National Railways Co.*

a), b), c) Yes.

## 8. Holland.

*Netherlands Railways.*

Have not gone into this question.

## 9. Portugal.

*Portuguese Railway Company.*

Are examining the evolution in the labour position.

a) When there is trouble try to remedy it.

b) Ineffectiveness :

— No.

— No.

— No.

— Sometimes.

c) Economic loss :

— No.

— Yes, sometimes.

## 10. Switzerland.

a) *Federal Railways.*

No.

b) *Rhaetian Railway.*

Have never gone into this question.



## 11. Syria.

a) *Damas-Hamah Railway.*

Nothing.

b) *Syrian State Railways.*

No.

## 12. Turkey.

*Turkish Railways.*

No.

## QUESTION 8.

*Do you envisage a revision of the scheme by which your personnel requirements are assessed? Do you intend to revise your method of recruitment? What are your plans? What methods do you consider worth while?*

## REPLIES.

It is a rather remarkable fact that no railway is thinking of revising its recruiting methods and determining its labour requirements.

Some are however investigating the possibility of certain modifications :

In future, the Deutsche Bundesbahn is only going to engage young staff, preferably just after they have completed their education. For permanent way and station work, they will choose vigorous men.

The R.E.N.F.E. will reduce its labour force by 10 % in two years time. They do not intend to change their present methods of recruitment.

On the S.N.C.F., the methods of deciding labour requirements are the subject of continual studies, but so far no decision has been come to on the various questions now being studied.

The Algerian Railways only take present requirements into account and available funds.

The Gafsa Railway proposes to set up a Works Motions Office attached to the Rolling Stock and Traction Department to

analyse the work and check the proper user of the labour available.

On the French West African Railways, recruiting methods are adapted to local contingencies.

The Luxemburg Railways are considering setting up new standards taking into account the special feature and small extent of the railway system. They will consult the S.N.C.F. and S.N.C.B. about this.

On the Portuguese Railways, the question is under study, as also on the Turkish Railways.

## III. RESUME OF THE REPLIES RECEIVED FROM THE RAILWAY ADMINISTRATIONS.

1. — The administration who replied to the questionnaire have a total of 1 650 000 employees.

The distribution of the labour force according to its functions varies very considerably : the percentage is from 19 to 65 for unskilled workmen, 3 to 47 for skilled workmen, 1 to 35 for supervisory staff, 6.5 to 63.5 for clerks, 0.5 to 2.5 for officials and 0.25 to 1.75 for technicians.

Distribution according to status is much closer between the different railways : the permanent labour force varies from 75 to 99 % except in the case of the Gafsa Ry. (64.5 %), French West African (33 %), Madagascar (27.5 %), Indochina Colonial Railways (24 %) and Cambodian Railways (19.65 %).

It appears therefore that colonial railways are those making the greatest use of temporary staff.

The criteria upon which the labour requirements are based are very variable, but the expected volume of the traffic is the most usual.

Supervision and control of the labour force is carried out by means of a filing system, and is usually done monthly.

Variations in the criteria have been dictated by modifications in working hours

and political and social conditions as well as the results of rationalisation.

— More than half the railways use the same criteria for ascertaining their permanent and temporary labour requirements.

In general, they all take seasonal or occasional work into account in fixing the amount of temporary labour required.

— The intake of temporary staff is determined by the amount of seasonal work and the need for more economical working.

The Italian Railways however do not engage any temporary staff.

The proportion of permanent and temporary labour varies very considerably except on the S.N.C.F., Tunisian, Madagascar and Viet Nam Railways where it is fixed respectively at 10 to 15 %, 55 %, 25 to 50 % and 50 %.

— Very few drawbacks attributable to recruiting temporary staff are reported. The chief are : difficulties in recruiting such staff owing to the uncertainty of the job and because it is less advantageous (S.N.C.B.), the criticisms of the trades unions (Tunisian Railways) the inferior quality of such staff (Portuguese and Swiss Federal Railways).

— Various degrees of priority are given to disabled ex-servicemen or civilians on the following railways : Deutsche Bundesbahn, Austrian Federal, S.N.C.B., National Light Railways, R.E.N.F.E., S.N.C.F., R.A.T.P., Algerian, Madagascar, Vietnam, Italian, North of Milan and Turkish Railways.

2. — Nearly all the railways are prepared to receive spontaneous demands from applicants for workman and clerical jobs.

Many announce vacancies by means of the press and radio.

Others make use of various labour offices.

Finally, in practice, all the railways recruit labour from the schools, technical training centres and universities.

— Certain railways have a systematic recruiting programme. Others have none.

Estimates of vacancies are usually prepared in advance.

Requests for employment generally form the basis of a reserve in recruiting labour; on other railways or for certain jobs such a reserve consists of the successful candidates in competitive examinations.

It is usual to impose certain general preliminary conditions.

Character testimonials are required and completed or replaced by an enquiry from the police.

It is exceptional to find that the railways have prepared set rules for the different trades or jobs.

Selective interviews are rarely held.

— Psychotechnical examinations are usually only required in the case of employees responsible for safety. They are carried out by specialists employed either by the railway or by private organisations.

Where this method is used, it has usually proved satisfactory.

— Recruiting is either regional or central. The final decision lies in general with the central administration but sometimes it has been decentralised.

— Recruiting is usually continuous, in accordance with requirements, rarely periodical. However, present day financial difficulties have led many railways to stop all recruiting of labour.

— Training either precedes engagement or follows it.

It may or may not include a period of initiation which may have various forms, either practical training, or training for a varying period in a railway school or other such establishment.

A very few railways teach new recruits everything about the railway whose employees they have become. As a general rule, the staff regulations or various regulations which directly affect the employee in question are distributed to him.

— The length of the probationary period is extremely variable, being from 1 month to 2 years.

In half the cases, there is an interview at the end of this period and a final examination.

— On many railways, these methods also apply to both the temporary and permanent staff, but very often the methods are more flexible in the case of temporary staff.

— Temporary staff have priority for being taken onto the permanent staff in fact or of right, except on the R.A.T.P., Cambodian and Syrian State Railways.

— Promotions for the workmen nearly always depend on their capacity and ability, rarely on their seniority.

It is exceptional for a workman to become a member of the clerical staff unless he succeeds in passing the prescribed examinations.

Promotion of clerical staff usually depends on ability, usually determined by the ability rating. Seniority is secondary.

On certain railways, vacancies are announced by being published. In other cases no such announcement is made, the management filling any vacancies according to the rules laid down.

It is rare for an examination to be set before promotion. Normally, the entrance examination dispenses from any further examinations, ability alone or nearly alone being taken into account for future promotion.

— Periodical examinations have to be passed by certain classes of staff on the Austrian, S.N.C.F., Tunisian, Vietnam, Portuguese and Turkish Railways.

Failure to pass means losing the job on the Austrian Federal and Tunisian Railways and delay in promotion on the Turkish Railways.

3. — Vacancies in the administrative and technical posts as well as all kinds of executive jobs are filled either by railway employees or by recruiting outside staff.

Many railways use both methods to a varying degree.

Vacancies in jobs for which university

courses are required are filled from outside, at least basically.

— The ability of employees suitable for promotion to higher jobs is estimated on nearly all railways by means of a competitive examination or test. The approval of their immediate superiors is also required as a general rule.

The S.N.C.B. makes use of two methods : an examination or report and a probationary period of 6 months or one year for each employee promoted to a higher grade.

— Nearly all the railways turn to the Universities, Higher Schools and Technical Schools for recruits.

The Otraco and Turkish State Railways also turn to the liberal professions.

The Deutsche Bundesbahn only takes candidates who have successfully passed the State examinations.

The French Colonial Railways find candidates through the S.N.C.F. and French Overseas Railway Office.

— Few railways make use of a systematic method of recruiting and still fewer have perfected sets of regulations for the various jobs.

The reserve consists of those who have entered their names or successfully passed the competitive examinations.

Vacancies are announced either exclusively within the undertaking, or both within the undertaking and outside it.

The same references and certificates are required for workmen and clerical staff.

Selection interviews are the rule on a few railways, carried out usually by higher officials or the heads of the departments concerned.

Psychotechnical examinations are rarely required. When they are, they have been found satisfactory.

— When a diploma is required, the class in which it was obtained is usually taken into account.

In spite of this, a public competitive examination is often set.



— These public competitive examinations include written or graphical tests, or oral tests, or an intelligence test, or a combination of several such tests.

— The most various criteria are used to select the tests used.

— Administrative and technical jobs for which a diploma is not required are filled from the results of public competitive examinations or professional tests.

— When recruiting for such jobs takes place by means of a public competitive examination, the railway employees who sit for them on most railways receive priority or an increase in the marks awarded.

— The subjects of such competitive examinations depend on the following criteria : nature and importance of the job, general basic knowledge or technical knowledge.

— Nearly all the Administrations pay more attention to ability than seniority for promotions. Ability is usually judged by the rating given but also often from the results of an examination.

— There is sometimes a selection committee which is also known as a classification committee or ability committee.

Suggested promotions are usually put forward by the heads concerned.

The final choice lies with the management, the general management or the administrative council, or the ministry.

— There are various methods of training, either by means of courses or service conference or practical experience.

There are training schools on certain railways. Such training takes place either before engagement, or afterwards.

4. — A fair number of railways have apprentice schools which train apprentices for various trades. A few railways have given up such schools or have organised apprenticeship courses in the ordinary shops.

— Conditions of admission vary greatly from one railway to another. The age limits are between 14 and 18 years.

All the railways give priority or increased marks to the children of employees.

On some railways such advantages are however also extended to other categories or for other reasons (family situation, education, war orphans, national scholars, grandsons of employees).

— The teaching of apprentices takes place in day time classes, rarely by means of correspondence courses. No railway has organised any evening classes.

The Deutsche Bundesbahn, Austrian Federal Railways, and Luxemburg Railways also make use of private schools.

In every case the schooling is completed by practical training.

— The duration of apprenticeship varies, according to the railway, from 9 months to 5 years.

Wages are usually paid.

— An official of the undertaking is appointed to supervise the selection and training of the apprentices on all the railways except the National Light Railways, Gafsa, Tunisian, Madagascar, Netherlands, Rhaetian, Damas-Hamah and Syrian State Railways.

— Apprentices have a priority of right, in fact, or a relative priority, to take up permanent employment, on all the railways, except the Italian Railways and R.E.N.F.E. (where apprentices are already considered to be part of the permanent staff).

— As a general rule, apprentices are trained first of all to become good tradesmen, and later on executive staff.

5. — A medical examination is obligatory on all the railways on engagement, whether it is a question of permanent or temporary staff.

On a fairly large number of railways a second medical examination is also required when passing from the temporary to the permanent staff or before being promoted to the higher grade jobs.

Finally, many railways require staff whose jobs are concerned with the safety or drivers

and machinists, and exceptionally all the staff, to pass periodic medical examinations.

The decision to admit or reject candidates belongs sometimes to the Medical Department and sometimes to the Administrations, in the latter case however, in agreement with the Medical Services.

Nearly all the railways have laid down regulations regarding the standards of physical fitness. Exceptions are the National Light Railways Company, Otraco, Swiss Federal Railways, Rhaetian Railway, R.E.N.F.E. (regulations in preparation), Italian Railways and Netherlands Railways.

A thorough medical overhaul is always insisted upon in the case of permanent staff.

Temporary staff are sometimes engaged without any medical examinations, or after a summary or less thorough examination than that required in the case of permanent staff.

— The medical examination on engagement is carried out by full time railway doctors on certain railways, and on others by ordinary medical practitioners not forming part of the railway staff.

The opinion of specialists is taken if this appears advisable.

6. — The rate of replacement is very low at present (about 1 %) on certain railways, but higher on others (5 to 6 %).

Several railways (Tunisian, North of Milan, Portuguese and Syrian State) have stopped recruiting altogether for several years.

— A few railways gave us the average number of employees for each five year period over the last 25 years.

It can be stated however that the policy everywhere is to reduce the staff considerably.

— The age limits vary usually from 60 to 65 years for sedentary staff, 50 to 55 years for the staff that travel about. In the case of voluntary retirement, these limits are usually reduced by 5 years, but a minimum number of years service is required.

The average age of premature retirement as a result of ill health varies considerably from one railway to another.

— The distribution of the staff in the various age groups shows that on nearly all the railways there is too low a percentage of young employees and a very high percentage of employees nearing the end of their career.

In general, the largest percentage is in the 36 to 50 years age groups.

This shows the effects of the considerable decline in recruiting new staff during recent years.

— Stopping or greatly reducing the intake of new staff has led to serious drawbacks : the mass retirement of officials who all reach retiring age at about the same time, and their replacement by young officials who have not had time to acquire the necessary practical experience and training needed, and whose promotion to managerial posts means that there is no hope of promotion for those below them.

— Out of 25 railways, 18 do not ascertain the reasons why some of their staff leave. On several however the staff give their reasons for so doing spontaneously.

— The information collected regarding the underlying causes of the evolution in the labour situation as well as their repercussions on the working is insufficient for any valid conclusion to be put forward.

— No administration is proposing to revise its methods of recruiting new staff or determining its labour requirements. Some however are studying certain modifications.

#### IV. FINAL APPRECIATIONS.

Re-reading the text of Question 7 and remembering the objectives which the reporters stated they had in mind in drawing up their questionnaire and sending it out to the various railway administrations, one is obliged to confess that though the data collected are abundant, and usually very clear and precise, they also are extraordinarily diversified, so that there are almost as many

systems, formulae, and methods as there were replies.

It appears that if any practical summaries are to be put forward, it would be better to start from zero, taking as basis the drawbacks resulting from the present systems and admitted in the replies, in order to avoid the same pitfalls in the future.

We are not turning a blind eye to the fact that it will be very difficult to suggest summaries which will be agreed by all or at least the majority.

This however will be the task of the special reporter, but the authors of the present report wished to put forward certain reflections and suggestions, thus hoping to give some small assistance to whoever is responsible for drawing up the summaries.

1) Whatever they may say and whatever they may think who state that they are satisfied with the present methods and have no intention of changing them, the authors of the present report have the impression that in no case is there any logical and rational method of recruitment, capable of attaining the objective laid down in question 7.

The authors are inclined to think that in every case the object has been to meet the difficulties then occurring (often successfully) but without asking (perhaps without being able to ask) if this was not going to create even greater difficulties in the future.

Undoubtedly, the measures taken enabled or will enable the greatest difficulties to be overcome. But care must be taken not to compromise the future whilst safeguarding the present by too radical measures : One does not kill a fly on an infant's forehead by hitting it with a hammer.

2) A common preoccupation seems to have guided the administrations : to meet the demands of the budget by reducing the staff as much as possible. This method finds additional justification in progress, modernisation, rationalisation.

But should this principle of unescapable reduction in the staff be carried out bru-

tally? Does it mean that for years not one single person is to be engaged, that none of the staff retiring, deceased or leaving are to be replaced, but even more employees dismissed?

Is it essential to achieve 100 % without any compromise, without any pause, the programme of reduction in labour that has been decided upon?

3) The problem is certainly much less important in the case of the workmen. Much of the work requires little or no training or experience on the part of the worker.

It is certain that in this case the intake of labour can be adapted constantly to the needs of the moment.

It is very different in the case of the higher grades, administrative or technical, the supervisory staff, who have to give the orders.

Here we consider it essential to have harmonious recruitment of employees assuring the regular replacement of those leaving by other employees having the necessary training and experience.

It is necessary to avoid, therefore, what is so often seen, officials close to retirement and coming after them as candidates for promotion to the administrative jobs young officials, full of promising qualities no doubt but lacking in experience and maturity, whose premature promotion to the top grades removes all hope of promotion from those following them and consequently all competition, as since they have got to the top straight away, they have no reason for trying to distinguish themselves.

The only way of overcoming this serious drawback would be to determine the minimum number of candidates for the higher grades to be recruited each year, *and to recruit them.*

4) Account should also be taken of the considerable increase in expectation of life : 50 % in half a century (from 42 to 63 years for men, and 67 for women).

Perhaps in the near future it will be



necessary to reconsider the whole question of the retiring age and the working life in terms of this factor, in conjunction moreover with the new progress which may be expected from the modernisation of the material and the rationalisation of working methods.

5) Finally, we should consider, without underestimating their importance, the repercussions of a social nature involved in a draconian and peremptory reduction in the staff.

We are dealing with men, not with machines.

6) To sum up our ideas, we would say that recruiting which ends in having two groups of employees, one very young, just starting their career, and one very old chiefly in the three last age groups, with practically no one between the two, is bad recruiting which one day will prove far more costly than all the economies it temporarily made possible at the time it was carried out.

## INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th. SESSION (LONDON, 1954).

### QUESTION 4.

## Means and methods to improve the efficiency of steam locomotives :

- a) increase of steam pressure,
- b) types of grates,
- c) superheating of the steam,
- d) preheating of the feeding water,
- e) feed water treatment,
- etc.

### REPORT

*(America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible),*

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Assistant Chief Mechanical Engineer (Motive Power), *South African Railways.*

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	(ii) Total vacuum relative to back pressure : class 23 locomotive . . . . .	South African Railways	G
H1	Comparative steam consumption with 3/16" and 1/4" valve lead : class WP. locomotive . . . . .	Indian Railways	H
H2	Comparative steam consumption with different valve gears . . . . .	Indian Railways	H
M1	Coal and water consumption per effective horse power hour relative to firing rate : class 23 locomotive . . . . .	South African Railways	M
M2	Steam and coal consumption per indicated and drawbar horse power hour relative to horse power : class WG. locomotive	Indian Railways	M
M3	Cylinder rating curves (relative to speed) : class WG. locomotive . . . . .	Indian Railways	M
M4	Variation of engine resistance with speed and cut-off . . . . .	Indian Railways	M

## DENMARK.

*Danish State Railways.*  
*Aalborg Privatbaner.*

## AFRICA.

*South African Railways.*  
*Sudan Railways.*

## ASIA.

*Indian Railways.*  
*Ceylon Government Railway.*

## AUSTRALIA.

*Victorian Railways.*

## INDONESIA.

*Indonesian State Railways.*

## SWEDEN.

*Roslagens Järnvägar.*

—

The smaller number of replies to the questionnaire on this occasion, as compared with those received in 1937 when this subject was previously dealt with by the Association, can be ascribed firstly to the fact that certain Railway Administrations either have changed over to electric or diesel traction, or are in the process of doing so. Secondly, a number of Administrations have advised that present circumstances have precluded them from sparing the time and personnel required to deal with the questionnaire.

From these last mentioned replies, and also from the nature of some of the replies to the questionnaire, it is quite clear that most, if not all, Railway Administrations are still much concerned with rehabilitation and consolidation after the hiatus caused by the last world war, and its aftermath, and for these reasons little in the way of technical advance has been reported.

As the 1937 Congress of the Association brought the subject matter of this chapter up-to-date at that time, this report deals with locomotives placed in service since that year, and developments which have taken place in the intervening period.

## A. INCREASE IN STEAM PRESSURE.

a) *Increase in pressure, if any, and reasons.*

Comparatively few of the locomotives (about 16 % in all) which have been placed in service from 1937 onwards have been designed to work at a higher pressure than had previously obtained on the Railways concerned. Moreover, the increases in working pressure have not been of any particular magnitude.

The Indian Railways report having a few locomotives with pressures of 225-250 lbs. per sq. inch (15.8 to 17.6 kg per sq. cm) but no further particulars are available.

Annexure A/3 gives particulars of the locomotives which have been reported as

<i>Railway</i>	<i>Highest pressure prior to 1937</i>	<i>Highest pressure since 1937</i>	<i>Number of locomotives</i>
Indonesian State Railways	200 lbs. per sq. inch. (14 kg. per sq. cm)	228 lbs. per sq. inch. (16 kg. per sq. cm)	100
Victorian Railways . . .	210 lbs. per sq. inch. (14.8 kg. per sq. cm)	220 lbs. per sq. inch. (15.5 kg. per sq. cm)	1
South African Railways	210 lbs. per sq. inch. (14.8 kg. per sq. cm)	225 lbs. per sq. inch. (15.8 kg. per sq. cm)	276

having been placed in service by the various Railway Administrations from 1937 onwards. All of these have the conventional type of boiler.

Where reasons have been given for not increasing the boiler pressure, that of keeping boiler maintenance figures down has been stressed. Added to this the South African Railways point out that with their narrow gauge of 3' - 6" (1 067 mm), the limitations imposed by the moving structure gauge, the maximum axle loading permitted and the adhesive factor a boiler pressure of 225 lbs. per sq. inch (15.8 kg per sq. cm) could not be exceeded with advantage without added complications of design.

The Indian Railways alone foresee an increase in the boiler pressure used, in order to benefit by the thermal advantages, as their boiler building industry becomes established.

No Railway makes mention of the possibility of putting into service anything but the conventional type of boiler.

#### b) *Characteristic boiler data :*

Characteristic boiler data for locomotives placed in service from 1937 onwards is given in Annexure No. 2, supplemented by additional information in respect of Indian Railways boilers in Annexure A/4, and in respect of the South African Railways in Annexure A/5.

Certain special features of the boilers of the modern rationalised locomotives on the Indian Railways are :—

- i) All welded steel fireboxes with combustion chambers;
- ii) Round top boilers;
- iii) Large grate area to burn low grade coal at economical firing rates;
- iv) One thermic syphon and two arch tubes;
- v) Minimum gas area of 12 %, and
- vi) Extended smokeboxes of ample volume with single point blast pipe.

Weights of boilers in service per kg/hour

of steam produced are shown for certain locomotives of the Indian Railways and the South African Railways on Annexure A/6.

#### c) *Materials used in boiler construction.*

Annexure A/7 gives brief specifications of boiler materials used by the Indian Railways and Annexure A/8, the same information for the South African Railways, Danish State Railways and the Victorian Railways.

Only the South African Railways report the use of special steels, but this was not due to consideration of the boiler pressures worked to but rather to consideration of weight. Trouble was experienced with the cracking of boiler shells made of steel shown under ii) in Annexure A/9 after 10-12 years service, but investigations showed that this was not due to the material. The cracks were of the stress corrosion type and were probably due to oversteering in certain areas.

In the past the South African Railways had a number of locomotives working in bad water districts equipped with copper or composite fireboxes, the latter being copper fireboxes with steel tube plates. With the advance in water treatment it is now the policy to replace copper by steel when firebox renewals become necessary.

With regard to the thickness of steel boiler plates the Victorian Railways work to the following formula for cylindrical shells :—

$$WP = \frac{2T \times Ft \times J}{FS \times Di \times 100} \text{ where :}$$

WP = working pressure in lbs. per sq. inch;

Ft = minimum ultimate tensile strength in lbs./sq. inch;

T = minimum thickness of shell plates in weakest course, in inches;

J = efficiency of longitudinal joint;

Di = inside diameter of weakest course of the shell, in inches.

Where the shell is not truly cylindrical but is slightly conical,



the same formula is used but the figure  $D_i$  is taken as the maximum inside diameter of the inside strake;

FS = minimum factor of safety which is 4.5 for new designs and construction, and 4 for existing boilers, calculated on the condition actually obtaining in service. The minimum thickness of plate used is  $3/8"$  and the maximum  $7/8"$ .

In the case of the Indian Railways the thicknesses of boiler plates are determined

Smoke box front plate and wrapper . . . . .	$5/8"$ (16)
Smoke box tube plate . . . . .	$7/8"$ (22)
Firebox tube plate (steel) . . . . .	$5/8"$ (16)
Firebox inner wrapper plate (steel) . . . . .	$3/8"$ (10)
Firebox inner back plate (steel) . . . . .	$7/16"$ (11)
Firebox inner wrapper plate (copper) . . . . .	$9/16"$ (14)
Firebox inner back plate (copper) . . . . .	$9/16"$ (14)
Barrel plates . . . . .	$11/16"$ , $3/4"$ , $7/8"$ (17, 19, 22)
Outer back plates and wrapper . . . . .	$5/8"$ (16)
Throat plates . . . . .	$5/8"$ , $11/16"$ , $3/4"$ (16, 17, 19)

In order to reduce the bending stresses in space stays recent designs have the outer wrapping plates and inner firebox plates of almost the same thickness.

#### d) *Characteristics of the fuel used.*

By far the greater proportion of locomotives reported upon are coal burning. Annexure A/11 gives particulars of the types of coal used by certain of the Railways replying to the questionnaire.

Particulars of locomotives burning oil fuel are given under the section dealing with types of grates.

#### e) *Future trends in increased boiler pressures.*

Of those Railways which referred to this point the South African Railways do not anticipate raising the pressure above the present maximum of 225 lbs. per sq. inch (15.8 kg per sq. cm).

The Danish State Railways consider that it is possible that pressures of the order

by the formula given in the Indian Boiler Regulations of 1950. In cases of components not covered by these regulations the A.S.M.E. boiler code for locomotive boilers is applied. Annexure A/10 gives the actual thicknesses of boiler plates in the more modern rationalised locomotives of the Indian Railways.

On the South African Railways no particular code is followed but plate thicknesses are arrived at by design principles, influenced in some degree by weight considerations. A fair measure of uniformity has been attained and the following dimensions are given as being usually adhered to :—

255-285 lbs. per sq. inch (18-20 kg per sq. cm) will be adopted.

The Indian Railways consider that pressures will progress by stages to 250 lbs. per sq. inch (17.57 kg per sq. cm) and possibly to 270 lbs. per sq. inch (19 kg per sq. cm).

### SUMMARY.

Steam pressures of boilers of the conventional type show no marked increase, and no boilers of special design have been produced.

The small increases that have been brought about have necessitated no special methods of testing, or maintenance and repair, not has it been necessary to use special steels on account of the pressures used.

Considerations of keeping maintenance costs down, and weight considerations in the case of narrow gauge lines, have been advanced as reasons for not adopting high boiler pressures.

## B. TYPES OF GRATES.

### a) *Development of types of grates.*

The Victorian Railways generally use shaker grates, although later engines have been equipped with grates of the Waugh type, while the Danish State Railways report best results with the plane, inclined grate (Annexure B/1). For burning coal with a high dust content good results have been obtained on some of the smaller types of locomotives, with a deep, plane horizontal grate, raised about 120 mm in the centre.

After tests with various types of grates the Indian Railways have standardised the finger pattern rocking grate, with air spaces of 1" to 1 1/8" (25 to 29 mm) as best suited to the low grade non-coking coals used. The grate is arranged for rocking by hand in sections. Annexure B/2 shows the boiler efficiencies obtained with various types of grates.

The South African Railways use finger bars, pin hole grates and slotted grates. The pin hole grate was developed on the introduction of mechanically fired locomotives and had no opening larger than 3/4" (19 mm) to prevent waste of unburnt fuel. The slotted type of grate has now been developed, with no opening larger than 5/8" (16 mm), and it is intended to standardise this type of grate, which is shown

in Annexure B/3. In recent designs, where possible, no dead grates are used and the whole grate area is made up of rocking and drop grates, the latter being disposed centrally in the grate. A level grate is aimed at.

### b) *Particulars of fuel and rates of combustion.*

Annexure A/11 gives particulars of the coals used by different Railways.

The coals used on the Indian Railways are described as non-clinking, and as high grade metallurgical coking coals are limited in supply, grates have been designed to burn the lower graded coals. Lignites of fairly good quality are available and research into their utilisation is to be undertaken.

The Victorian Railways have equipped one locomotive to burn pulverised brown coal for trial purposes.

On the South African Railways, due to the limitations worked to, it is the endeavour to obtain coal with as high a calorific value and low ash content as possible and it is not the intention to investigate using other types of coal. Contract specifications stipulate a minimum size of 1 1/4" (32 mm) and a maximum of 6" (150 mm).

Rates of combustion are given as follows (in kg per sq. m per hour) :—

<i>Railways</i>	<i>Class</i>	<i>Peak load or maximum</i>	<i>Moderate gradient or usual</i>	<i>Cruising</i>	<i>Grate area sq. m</i>
Danish Railways	E.	445	415	—	3.60
	H.	570	495	—	2.62
	P.	450	330	—	3.23
Indian Railways	—	660	440—536	342—390	—
South African Railways	19D.	550	—	—	3.35
	23	830	—	—	5.85
	(stoker fired) 15F. (hand fired)	635	—	—	5.85

c) *Grate proportions and air openings in grate and ashpans.*

The following data is given by the Railways concerned regarding the air openings through the grate and the ash pan on their locomotives :—

**Air opening as percentage of grate area.**

	<i>Through grate</i>	<i>Ashpan</i>
Victorian Railways . . . . .	22 % (testing 27 %)	14 % (damper doors.)
Danish State Railways . . . . .	40 %	30 %
Indian Railways (Broad gauge) . . . . . (Medium gauge) . . . . .	39.8 — 43 % 50.5 — 52 %	15.75 — 21.2 % 15.0 — 19.8 %
South African Railways . . . . .	32 % (slotted type)	12 % (Minimum)

Annexure B/4 gives data concerning the grates used in the new standard Indian Railway locomotives.

The Indian Railways have also found that a table grate with hexagonal holes (known as a honey-comb grate) with air space/grate area ratio approaching 30 % is suitable at high rates of burning with small coal, as fired by a mechanical stoker.

No Railways report using any special device in their ash pans to facilitate correct distribution of air over the grate.

The Indian Railways mention experiments being made with secondary air in order to minimise the losses due to unburnt particles of fuel being carried over, but

apart from this on all Railways air above the fire is admitted through the fire hole door in the normal course of handling the locomotive.

No Railways report any special steps or devices to avoid clogging of the grates, with the exception of the South African Railways, where the openings in the grates are given a liberal taper, diminishing in size from the bottom to the top, with the object of keeping the openings clear.

d) *Materials used for grates and their life.*

The following data has been given on this item :—

<i>Railway</i>	<i>Material used</i>	<i>Life</i>
Aalborg Privatbaner	Cast Iron	2 — 4 years
Victorian Railways	Cast Iron	4 years (Waugh type)
Danish State Railways	Rolled mild steel	6 to 18 months
Indian Railways	Low grade cast iron	4 years
South African Railways	Cast Iron	1 1/2 to 2 1/2 years



e) *Brick arches : specification and life :*

<i>Railway</i>	<i>Specification</i>	<i>Life (approx.)</i>
Victorian Railways	—	12 000 miles
Danish State Railways (Chamotte Bricks)	Al <sub>2</sub> O <sub>3</sub> — 35 % Silicon — 65 % Melting point 1 725°C. Yield point 1 320 - 1 535°C	2 months
Indian Railways (Indian Standards Specification IS. 6 of 1949)	Silica (SiO <sub>2</sub> ) not more than 65 %. Alumina (Al <sub>2</sub> O <sub>3</sub> ) not less than 30 %.	3 to 6 months
South African Railways (S.A.B.S. specification 35 — 1949 for normal duty fireclay brick).	Cold crushing strength — Not less than 1 800 lbs/in.  Refractoriness under load — not more than 3 % subsidence at 1 350°C. under 28 lbs/sq. in.  Pyrometric cone equivalent not lower than Seger Cone No. 28 (i.e. at 1 630°C).	3 to 6 months

In all cases coal is the fuel used.

f) *Design and dimensions of brick arches.*

Proportions of brick arches as used by the Danish State Railways are shown on Annexure B/5. But for the complications introduced in respect of the inspection and cleaning tube plates longer arches would be favoured.

The practice of the Indian Railways is to proportion the length of the brick arch so that the area between the top of the arch and the firebox crown is at least 120 % of the free gas area through the tubes and flues. New locomotives are being built with deeper fireboxes to increase firebox volume for better combustion of volatiles and it has been found that increasing the

dimension « h » of the arch above the grate to the maximum possible extent (see Annexure B/6) reduces the carry over of sparks.

South African Railway practice is to make the area between the top of the arch and the firebox crown 13 to 14 % of the grate area. On this basis the ratio of the area between the top of the arch and the firebox crown to the free gas area through the tubes and flues, for the more modern locomotives, varies from 75 % to 115 %. In this range the lower ratios apply to Garratt locomotives. In the design of the arch it is endeavoured to have equal vertical ordinates between the arch and the crown of the box, and wherever possible, dependent on the shape of the box, the

end of the arch kept at least 3'-0" (914 mm) from the back plate.

The South African Railways report that it has been found, with equal Wagner ratios for flues and tubes, the arch should be at an angle of 30° to the grate as well having the desired opening between arch and crown. With different Wagner ratios for flues and tubes this angle requires to be modified. Annexure B/7 shows the overall boiler efficiencies for two angles of arch in a standard 3B boiler as fitted to a class 23 locomotive. At firing rates lower than 100 lbs. per sq. ft. per hour (490 kg per sq. m per hour) the efficiency is lower with a 30° arch than with a 28° arch, due to excess air, but in the normal working range between this rate of firing and the maximum of 170 lb. per sq. ft. per hour (830 kg per sq. m per hour) there is an appreciable gain in efficiency with a 30° arch.

g) *Maximum grate area, and rate of firing, for hand firing.*

Those replying to this item are generally agreed that the maximum size grate which can be hand fired is from 50 to 60 sq. ft. (4.65 to 5.57 sq. m).

Apart from the question of grate size there is the important factors of the rate of firing and the total amount of coal handled in relation to the fireman's physical capacity. The Indian Railways considers that the following rates of firing are the limit of a single fireman.

- i) For continuous period :  
3 500 lbs/hr. (1 590 kg/hr.);
- ii) For one hour or less :  
4 500 lbs/hr. (2 040 kg/hr.);
- iii) For 15 to 20 minutes :  
5 200 lbs/hr. (2 360 kg/hr.).

The South African Railways have observed firing rates up to 8 000 lbs. per hour (3 630 kg/hr.), but for periods no longer than half hour to an hour. However, a better criterion is considered to be the total coal handled per shift and when this exceeds 10-11 short tons (say 9 000 to 10 000

kg) it is deemed essential to change to mechanical firing.

h) *Locomotives equipped with mechanical stokers.*

The following Railways report having locomotives equipped with mechanical stokers :—

Victorian Railways :

71 classes R & H locomotives equipped with type MB.I. Standard stokers.

Grate areas 42 and 68 sq. ft., respectively (3.9 and 6.31 sq. m).

Indian Railways :

36 class XE, 2-8-2 heavy goods locomotives, of which 35 are equipped with Berkeley stokers and one with type HT.I. Standard stoker. Grate area 60 sq. ft. (5.57 sq. m).

South African Railways :

Including locomotives now being fitted and locomotives on order, this railway system will have 582 stoker equipped locomotives.

Grate areas range from 56 to 75 sq. ft. (5.22 to 7.0 sq. m). See Annexure B/8.

i) *Economic results.*

None of the above-mentioned railways has drawn up an economic balance sheet, but the Indian Railways observe that the coal consumption with stoker firing is heavier than with hand firing. The difference in favour of hand firing is given as 5 to 8 %. Arising out of dynamometer trials of the class XE.I locomotives this is put down to :

- 1) Insufficient furnace volume resulting in carrying over of unburnt slack and dust;
- 2) Lack of secondary air above fuel bed;
- 3) Excessive loss of slack through fire-bars, due to rocking of grates, and
- 4) Steam used for stoker operation.

Fuel consumption is given as :

- 1) 3 500 - 4 200 lbs/hour (1 590 - 1 900

kg/hr.), equal to 18.1 kg per 1 000 ton-kilometres for current schedules, and

2) 4 850 - 6 400 lbs/hour (2 200 - 2 900 kg/hour), equal to 26 kg per 1 000 tons-kilometres accelerated schedules as applied to the particular graded sections on which the loads are hauled.

The throwing of cinders through the chimney, which is enhanced at higher working rates, is partially checked by the spark arrestor screens. It is found that the combustion space temperature is 200-300° F higher in the case of stoker locomotives, since keeping the fire door closed results in more uniform draughting conditions.

Stokers are specified for new heavy goods locomotives with grates of 70 sq. ft. (6.5 sq. m).

The South African Railways have carried out comparative tests with standard 3B boilers in a class 15F locomotive (hand fired) and a class 23 (stoker fired) which show conclusively that combustion efficiency, when hand firing, is far superior to mechanical firing under identical conditions of working.

The saving in coal being from 10 % to 25 % over the normal working range of the locomotive. (See curve 1, Annexure G/9). Curves 5.6 and 7 on Annexures G/10 and B/9 show the results obtained for evaporation against firing rate for the two locomotives.

#### j) *Oil firing of locomotives.*

Certain of the locomotives of the Indonesian State Railways are oil-fired but further particulars are not available.

All 124 main line locomotives on the Sudan Railways are fired with oil to the specification :

Viscosity, Redwood 1, at 100° F : 1 000 secs. max.;

Sulphur content : 3.8 max.;

Calorific value (gross or higher) : 18 000 B.T.U's per lb. (min.).

All locomotives are equipped with a Laidlaw Drew burner, and existing loco-

motives are being converted to this burner from the Mexican trough system which gave considerable trouble. The locomotives were originally designed for coal burning, but although oil burning in such fireboxes is not trouble free the low cost of oil makes its use a practical proposition.

Eighty three locomotives on the Victorian Railways are equipped to burn heavy residual oil, the conversion being due to a shortage of black coal rather than from any economic aspect.

Both the Indian Railways and the Danish State Railways have had a few oil burning locomotives but have converted them to coal burning.

#### SUMMARY.

The tendency is towards freedom of air flow through ashpan and grate although there is little uniformity in the proportions used by different Railways. This is understandably due to the differences in the physical and chemical differences in coals used.

Finger bar grates, which give the largest air opening, are successfully used with hand firing but with the use of smaller size coal as fired by mechanical stokers perforated or table grates (honey-combed or slotted) are favoured. No advanced designs of grates are reported upon.

Cast iron is most favoured for grates. The life of grates varies rather widely on different Railways, ranging from 1 1/2 to 4 years.

The design of brick arches has received careful study on several Railways which have paid attention to such features as length, area between top of grate and crown of firebox, and angle of the arch relative to the grate. The life of firebricks varies from 2 to 6 months.

Experience has shown that mechanical stokers are wasteful of coal as compared with hand firing but reports show that their use is on the increase for heavy working which is beyond the physical capacity



of the fireman and, in some cases, in order to utilise slack and small coal.

Oil firing, except in the case of one country, where oil supplies are close to hand, is not judged an economic proposition by the majority of the Railways.

### C. SUPERHEATING.

#### a) *Temperatures obtained and trend in temperatures.*

The Victorian Railways consider 650° F (344° C) to be a reasonable temperature although temperatures up to 740° F (394° C) have been obtained in practice. The boiler pressures of the modern locomotives range from 175 to 210 lbs. per sq. inch (12.3 to 14.8 kg per sq. cm).

A temperature of 698° F (370° C) is generally obtained on the modern locomotives of the Danish State Railways at boiler pressures of 170 and 185 lbs. per sq. inch (12 and 13 kg per sq. cm).

The highest superheat temperature recorded on the Indian Railways is 710° F (376° C) at a boiler pressure of 210 lbs. per sq. inch (14.8 kg per sq. cm), while in the case of the South African Railways temperatures of 700 to 710° (371 to 376° C) are designed for irrespective of boiler pressure.

The Indian Railways are aiming at a temperature of 730° F (388° C) and hope eventually to work at 750° F (400° C) but are approaching this upper limit conservatively until more research is done on grain growth in cast iron superheater headers and on lubrication.

The South African Railways have experienced difficulties in ensuring adequate lubrication above 700° F (371° C) and do not indicate an intention of exceeding this figure in their designs.

Annexures C/1 and G/11 (curve 3) show variations of steam temperature against firing rate.

#### b) *Superheater arrangement.*

The generally accepted practice is the

use of large flue tubes, about 5 1/4" to 5 1/2" outside diameter (133 to 140 mm), with « A » type elements having four passes in the flue tube. Elements are from 1 3/8" to 1 1/2" (35 to 38 mm) outside diameter and the passes are joined by solid forged return bends.

The Danish State Railways record that the type with two elements in the smaller flue tube often gives trouble through becoming choked with soot.

Generally the distance from the return bends at the firebox end to the firebox tube plate varies from 14" to 20" (356 to 508 mm), although the Victorian Railways have certain locomotives with this distance as short as 8" to 10" (203 to 254 mm).

Grey cast iron is the generally accepted material for superheater headers, the elements being provided with solid forged spherical end seatings. An exception to this form of element seating is found in the Danish State Railways where flat seatings are used. The use of solid forged return bends is general practice. Elements are supported in the flue tubes by means of mild steel shoes welded to the element support bends.

#### c) *Drop in pressure from boiler to valves.*

The Danish State Railways give the drop in pressure from the boiler to the steam chest, for normal running, as 1 - 1 1/2 kg per sq. cm (14 to 21 lbs. per sq. inch) for classes P and H locomotives, and about 2 kg per sq. cm (28 lbs. per sq. inch) for class E locomotives. The Indian Railways give this figure as approximately 10 lbs. per sq. inch (approximately .7 kg per sq. cm) at normal range of cut offs.

#### d) *Special devices to prevent carry over of water.*

The Victorian Railways use a tangential type of drier in the domes of their locomotives, while the Danish State Railways use a dryer, as shown on Annexure C/2, on classes E and H locomotives.

The South African Railways use no spe-

cial device to prevent water being carried over, but as their larger locomotives have no dome, owing to height restrictions, the collector pipes are bifurcated and fitted with organ pipes for collecting the steam. Annexure A/12 shows diagrammatically the arrangement on the standard 3B boilers fitted to the classes 15F and 23. On the new class 25 locomotives a single collector pipe is provided and has slots in the upper surface for collecting steam.

e) *Maintenance of superheater elements.*

The policy on the Victorian Railways is to fit new elements in boilers going out of workshops for a 4 year period, and to use repaired elements in 2 year period boilers.

The Danish State Railways give 100 000 to 150 000 km (62 000 to 93 000 miles) as the life of elements, and that of the joints between elements and the header as nearly the same.

The South African Railways report leaking joints as the most common form of element trouble by far, followed by burst elements and cracked or broken elements, in that order and in the ratio 14:4.5:1. Element replacement is heaviest in the case of the upper row and decreases regularly to the lowest of the 4 rows in the ratio 1.7:1.5:1.3:1.

f) *Economic balance sheet and conclusions.*

The general standpoint is that the thermal benefits which could be obtained by increasing superheats cannot be pursued to too high a temperature because of difficulties which would be experienced with grain growth in cast iron and with lubrication. The upper limit of the temperature which can be used with advantage is variously put at 700° F and 720° F (370° and 383° C).

With regard to the relationship between the various components of the superheater and the boiler, the South African Railways endeavour to obtain a Wagner ratio of

400 for both the large flue tubes and the smaller boiler tubes. In certain cases this cannot be attained and there are examples of Garratt type locomotives where the ratio is as low as 370 to obviate using boiler tubes less than 2" (51 mm) in outside diameter in order to avoid blocking up with char. To minimise the resistance to gas flow it is endeavoured to keep the ratio between the free gas area through the tubes and the grate area to 12 1/2 %, although the figure is as high as 17 % for certain Garratt type locomotives. With proper draughting, it is reported, the optimum steam temperature is obtained if the free gas area through the flue tubes is not more than 52 % of the total free gas area through flues plus tubes. The maximum should preferably be 50 %. The ratio of heating surface to grate area varies between 43 (for boilers with combustion chambers) and 53 (for boilers without combustion chambers). The minimum ratios allowed are 40.5 and 46.5 respectively.

Wagner ratios for the more modern locomotives of the Victorian Railways vary from 373 and 392, for the flues and tubes respectively, in the case of class K locomotives to 472 and 453, for flues and tubes, in the case of classes N and X locomotives. The general practice is to arrange the nests of elements in the upper section of the tube plates in large flue tubes.

g) *Lubrication.*

Annexure C/3 gives the characteristics of the oils used by different Railways for the lubrication of pistons and valves, at superheat temperatures referred to in a) above.

Mechanical lubricators with diaphragm check valves are used by the Victorian Railways. Atomised feeds are introduced into the steam pipe adjacent to the steam chest and into the top of the cylinder, and a solid feed to the bottom of the cylinder.

The Danish State Railways also use mechanical lubricators, which are adjusted to deliver two thirds of the oil to the valves and one third to the cylinders. The

lubricators are steam heated and the oil is fed to nozzles of which there are usually two per valve and two per cylinder.

The Indian Railways use hydrostatic lubricators.

Until recently the South African Railways used hydrostatic lubricators almost exclusively. However, all the locomotives now coming into service are equipped with mechanical lubricators. The practice on these railways is to feed the oil to atomisers situated in the main steam pipes in close proximity to the steam chests. In addition there are independent direct feeds to the cylinder walls.

The following data is given in respect of oil consumption for pistons and valves :—

*Victorian Railways :*

1.1 kg per 100 km (average).

*Danish State Railways :*

1.0 kg per 100 km (Class E);

0.8 kg per 100 km (Class H);

0.9 kg per 100 km (Class P).

*South African Railways :*

Class 15F (heavy main line) :

0.73 kg per 100 km;

Class 19D (branch line) :

0.57 kg per 100 km;

Class S (heavy shunting) :

0.41 kg per 8 hour shift.

*Indian Railways :*

Passenger and mixed :

2.9 kg per 100 km;

Goods :

3.58 kg per 100 km.

(Total consumption, engine and cylinders.)

*h) Characteristics of rings, valves and pistons.*

The general practice is to use solid cast iron pistons, except that in the larger sizes the Indian Railways and the South African Railways use cast steel centres with cast iron junk rings riveted on the periphery. Cast iron piston rings are standard in all

cases, but the South African Railways have adopted segmental rings of cast iron and bronze, of proprietary design, for their new locomotives now coming into service.

The Victorian Railways and the Danish State Railways use tailrods on their pistons, while the Indian Railways and the South African Railways do not.

The use of cast iron piston valve rings is general.

The Danish State Railways turn their rings circular and peen them afterwards. The average life is given as about 50 000 km (31 000 miles). On the South African Railways rings are usually renewed at intervals of about 15 000 miles (24 000 km) when locomotives are given a thorough examination and renewal of worn parts. This does not necessarily mean the actual life of the rings, but the examination is designed to obviate, as far as possible, the stopping of a locomotive before the next 15 000 miles has been covered.

The life of bull rings on the South African Railways varies over extremely wide limits ranging from 12 000 to 115 000 miles (19 000 to 184 000 km) and is influenced largely by the ovality of the cylinder liners and the rate of increase in this ovality.

*i) Piston and Piston valve rod packings.*

Cast iron and various alloys are used by the different Railways for their packings, there being little uniformity in this respect. The Victorian Railways use the « King » type packing with a white metal containing 80 % lead and 20 % antimony. The Danish State Railways use a cast iron packing, as do the Indian Railways in their « Britallic » packing. The latter also use bronze in their « Paxton-Mitchell » packing, but to a lesser extent. The South African Railways use an alloy composed of 66 % lead, 33 % copper and 1 % sulphur (max.). The « United Kingdom » type of packing predominates on these Railways but the latter classes of locomotives are fitted with « Paxton-Mitchell » packing.

Both the Danish State Railways and the



Indian Railways indicate that the cast iron packing used has not been altogether satisfactory. The former propose trying out red brass and the latter a special cast iron.

Because of the fact that inside admission piston valves are used, with the result that the valve rod packing is not subjected to high pressures, the South African Railways use ordinary packing of the graphite impregnated hemp type.

The Danish State Railways give the temperature of the steam in contact with the packing as 350° C (660° F). The South African Railways state that their P.66 packing has a softening temperature of about 300° C (572° F).

Both the Indian Railways and the South African Railways use swab boxes, or syphon feed lubricators, to lubricate the piston rods which also serve to lubricate the packing.

The Victorian Railways give the life of the packing as about 12 000 miles (19 000 km) and the South African Railways about 15 000 miles (24 000 km).

Plain carbon steels are generally used for piston rods, the Indian Railways material having an ultimate strength of 40-45 tons per sq. inch (63-70.9 kg per sq. mm), while the South African Railways use a steel with a tensile strength of 32-38 tons per sq. inch (50.5-60 kg per sq. mm).

#### SUMMARY.

1) The approach to higher superheat temperatures is conservative having regard to the possibility of lubrication difficulties and deterioration of metals at higher temperatures than are now attained. In general 700° F (370° C) is looked upon as a workable maximum, with a possibility of working at 750° F (400° C) provided research shows that the two abovementioned difficulties can be met at this temperature.

2) The « A » type element, with four passes in the flue tube, is in general use and there is no indication of any departure from this type. There is also no inclination shown to adopt any more complicated

form of element because of better heat absorption characteristics.

3) There is no general tendency to use devices to prevent the carry over of water to the superheater. In some cases dimensional restrictions militate against the use of such devices.

4) The use of cast iron piston and valve rings is practically general, although one railway is adopting segmental type rings of cast iron and bronze on a fairly large scale.

5) There is little uniformity in the types of piston and piston valve rod packings which are used by the different Railway Administrations.

\* \* \*

#### D. PREHEATING OF THE FEED WATER.

The Sudan Railways have 34 locomotives equipped with Weir type feed water heaters with Worthington pumps. It has been found that preheating reduces boiler maintenance, where this is due to scale formation, but that this is offset to some extent by the maintenance of the pump and heater. The economy in fuel and water is reported to be very small.

The Danish State Railways have used both the Worthington and the Knorr types of feedwater heaters on their classes H and P locomotives, but some 10-15 years ago they were removed owing to the rather heavy maintenance costs. Exhaust steam injectors were tried some 25 years ago, but their use was not continued as their reliability is said to have been unsatisfactory.

Feedwater heaters are not in general use on the Indian Railways. Limited experience in the past showed that they were difficult to maintain in service unless specially trained staff were provided in running sheds.

On the other hand dynamometer car tests have shown that a fuel economy of 5 to 7 per cent can be obtained under normal service conditions, the lower figure being representative of heavy goods ser-

vices where frequent use of the live steam injector is required to supplement the feed-water heater in meeting the steam demand in the boiler. It is stressed that to obtain satisfactory service with any type of feed water treated water is essential.

It is the intention of the Indian Railways to undertake shortly trials with surface preheaters using exhaust steam.

On the South African Railways certain locomotives were originally equipped with exhaust steam injectors, but these were removed as they did not operate entirely satisfactorily in service and required excessive maintenance. No locomotives are equipped with preheaters owing to axle load limitations.

### SUMMARY.

Compared with the period preceding the 1937 Congress, when appreciable progress in the preheating of boiler feed water was reported, retrocession is now evident in the cases of the railways dealt with in this Report, primarily on the score that the maintenance required by the appliances outweighs the advantage of increased boiler efficiency.

\* \* \*

### E. TREATMENT OF THE WATER.

(See also summary of individual replies at end of section.)

#### a) *Types of treatment.*

All Railways replying to the question-

naire use chemical treatment of boiler feed-water in some form or another.

Several of these Railways introduce the reagent into the tender either by hand or by means of a special device, while the Danish State Railways prefer a feeder attached to storage tanks.

It is the accepted practice on the South African Railways to treat externally to the boiler by precipitation (i.e. lime-soda sodium aluminate softening), or by base exchange (sodium cycle). The following supplementary methods of treatment are also used :—

1) With supplies treated in lime-soda softeners simple basket feeders in the treated water collecting troughs or storage tanks are used to dissolve briquettes and/or wattle tannin lumps;

2) With supplies treated in base exchange plants bypass feeders are used to dissolve tannin and fused soda ash;

3) In other cases chemicals for internal treatment, or final conditioning, are proportionately fed by :

- i) water motors and chemical pumps;
- ii) electrically driven chemical pumps,

or

iii) by pass feeders.

b) *Types of water treated, and end results.*

The Danish State Railways and the Indian Railways give the following analysis of typical waters (converted to parts per million) :—

	INDIAN RAILWAYS		DANISH STATE RAILWAYS
	<i>Bolotra</i>	<i>Pipar City</i>	
Total dissolved solids . . . . .	1 046	750	574
Total hardness (as CaCO <sub>3</sub> ) . . . . .	329	272	368
Total magnesia hardness (as CaCO <sub>3</sub> ) . . . . .	103	30	—
Carbonate hardness (as CaCO <sub>3</sub> ) . . . . .	226	242	164
Non-carbonate hardness (as CaCO <sub>3</sub> ) . . . . .	103	30	204
Sulphate (SO <sub>4</sub> ) . . . . .	260	116	192
Chloride (Cl) . . . . .	267	198	56
Silica (SiO <sub>2</sub> ) . . . . .	16	—	12
pH . . . . .	—	—	7.9

The Danish State Railways control treatment so that the water will have an excess alkalinity of 20-25 %, while the Indian Railways adjust the dosage to give a pH of 9.5 - 10.5.

On the Indian Railways, Eastern section, where the hardness of the water is below 12 degrees and the consumption under 10 million gallons per year bypass feeders using briquettes of alkaline reagents, with organic coagulants of the tannin/lignin type, are installed at intermediate stations linking up stations at which lime-soda softeners are installed. Only supplies with a total hardness in excess of 10 grains per gallon (143 p.p.m.) are considered suitable for external treatment, provided the annual consumption exceeds 10 million gallons per year.

South African Railway practice is to treat externally all waters having a total hardness in excess of 200 p.p.m. Final conditioning is by means of sodium phosphate, sodium hexameta phosphate and tannin.

All treatment is adjusted to give the ratio :—

$$\frac{\text{Total alkalinity expressed as CaCO}_3}{\text{Total non-incrusting solids}} = 25 \%$$

with excess tannin. Antifoam compound (polyamide type) is used if it is found necessary to operate with high concentrations of salinity.

#### c) *Effects of softened water :*

##### i) *Priming.*

Two Railways report that water treatment has completely eliminated priming, while the others, although troubled by this phenomenon to some extent, report that it can be kept under satisfactory control by the use of anti-foam compounds and blowing down.

The experience of the South African Railways is that a limit of salinity of approximately 3 000 parts per million, without using anti-foam compounds cannot be exceeded without priming (foaming) occurring. With modern polyamide type anti-

foam treatment limits of 10 000 p.p.m. are worked to. It is as yet considered inadvisable to work to higher limits in view of possible corrosion of boiler components.

##### ii) *Corrosion or pitting.*

Very little corrosion of metals is experienced and then not of a serious order. The South African Railways report corrosion of water level glasses with high alkalinity waters, necessitating tests in order to obtain a glass with higher resistivity to this action.

##### iii) *Attack of fusible plugs.*

Three Railways report corrosion of fusible plugs. The Danish State Railways had this trouble when using pure tin and cured it by changing to an alloy with the composition 85 % Sn, 10 % Sb and 5 % Cu.

The South African Railways report the corrosion of the pure lead used in their plugs resulting from high alkalinity as a limiting factor in the extension of the period between washouts. Tannin is relied upon to minimise this corrosion, while tests have been carried out with electroplating the plugs, with a degree of success. An obstacle to this procedure is the practice of stamping the lead of the plugs with the date they are put into boilers.

##### iv) *Scale formation :*

Very little formation of scale in injectors, delivery pipes or on boiler tubes, where the feedwater enters the boiler, is reported, this being put down to the adoption of appropriate water treatment. Most Railways fit deflector plates at point of entry of the feedwater into the boiler.

##### d) *Blowdown.*

##### i) *Conditions requiring blowing down.*

The Victorian Railways find blowing down necessary only when the dissolved solids exceed 180 grains per gallon (2 600 p.p.m.), while the Danish State Railways experience no trouble with salinity up to



200-300 p.p.m.  $\text{Cl}^1$  provided anti-foam compounds are used in the treatment.

The South African Railways find that waters containing approximately 400 p.p.m. of non-incrusting salts, treated by the addition of alkalinity ( $\text{Na}_2\text{CO}_3$ ,  $\text{NaOH}$  and sodium phosphates) to take care of non-carbonate hardness and to render water non-corrosive, can produce priming and use of anti-foam compounds and blowing down is necessary.

The Indian Railways use a dose of 1/2 lb. (227 gms.) to 1 000 galls. (4 546 litres) of a mixture of tannin, soda ash and soda aluminate in conjunction with a blow down of about one minute at each watering station.

ii) *Type of blow down device.*

One Railway fits a continuous blowdown linked up with the production of steam, while two Railways have only fitted hand operated blowdown cocks. The remaining three Railways replying to this item have both continuous blowdown devices and hand operated blow down cocks. Of these the Danish State Railways prefer the continuous blowdown, while the Indian Railways prefer hand operated blowdown cocks because of the tendency of the orifice of the continuous blowdown valve to become clogged.

All South African Railway locomotives are provided with hand operated blowdown cocks, in addition to which a number of locomotives on various sections are equipped with continuous blowdown as well. An overriding manual control of the continuous blowdown is favoured. It is not the practice to use the constant blowdown merely for sludge removal; the large hand operated blowdown cocks are used for this purpose.

iii) *Rate of blowdown.*

On the Danish State Railways the amount of blowdown is 4.5 % of the water evaporated, while on the Indian Railways 350-400 gallons (1 590-1 820 litres) are blown down on each occasion, equivalent

to 15-20 % of the water evaporated per hour under average working conditions.

On the South African Railways the percentage blowdown is calculated taking into consideration both the total non-incrusting solids in the feed water and the total non-incrusting solids that tests have shown to be the highest safe concentration that can be carried. If the partial blowdown required is in excess of 7 % of the total water used then anti-foam compounds are used to reduce the blowdown necessary.

The rate of blowdown with the large hand operated blowdown cock is approximately 100 gallons (450 litres) per minute. With the constant blowdown the rate is approximately 2 1/2 gallons (12 litres) per minute with a 3/16" (4.7 mm) orifice and 4 1/2 gallons (20 litres) per minute with a 5/16" (7.8 mm) orifice (excluding 20 % flash in both cases).

iv) *Increase in period between washouts.*

Considerable increase in the period between washouts are reported by all Railways replying to this item; at the least three times the period observed before water treatment was adopted.

e) *Gains due to reduced maintenance.*

Railways replying on this subject reported reduced maintenance of their locomotives. Victorian Railways refer to an improvement in tube life from two years to four years, and on the Danish State Railways the period between major boiler overhauls has been extended from four to five years.

The South African Railways report a reduction in the cost of major boiler overhauls of about 30 %, and that the condition of the boiler tubes has so improved that the re-ending of tubes at major overhauls is now standard practice.

## SUMMARY.

All reporting Railways have gained considerably from the introduction of the treatment of boiler feed water and there

is evidence of the tendency to extend the policy further.

Water conditions vary so widely on different Railway Systems, and indeed on individual Railways, that standardisation of methods of treatment does not at this stage appear feasible.

The success of a water treatment scheme depends largely on rigid control and it is necessary to set up the requisite organisation to exercise this control.

\* \* \*

## E. TREATMENT OF WATER.

### Summary of individual replies.

1) *Physical treatment of water inside the boiler.*

No replies in the affirmative.

2) *Chemical treatment of water inside the boiler.*

All Railways replying to the questionnaire use this form of treatment.

a)-c) *Method of introducing reagent into tender :*

*Aalborg Privatbaner :*

By hand.

*Sudan Railways :*

By hand.

*Ceylon Government Railway :*

Either into the boiler direct after wash-out or into the tender.

*Danish State Railways :*

Either by hand into the tender or by means of feeders to the storage tanks. The latter method is preferred and eventually will apply to all treatment.

*Indian Railways :*

Reagent introduced into specially designed tanks fitted to tenders.

*South African Railways :*

Hand feeding into tender only practiced

during the period of study prior to deciding on a treatment scheme, for the introduction of anti-foam compounds or while awaiting installation of treatment plant. The use of some special device is preferable to hand dosing direct into tender.

3) *Introduction of chemicals direct into the boiler :*

*Ceylon Government Railway :*

In certain cases the chemical is introduced directly into the boiler after weekly washout.

4) *Chemicals used for treating water inside boiler :*

*Aalborg Privatbaner :*

Alkaline reagents, with organic coagulants, tannin/lignin type.

*Sudan Railways :*

Tannin and anti-foam when required. Lime-soda softeners at certain points.

*Ceylon Government Railway :*

Proprietary organic compounds used alone.

*Victorian Railways :*

Soda ash and tannin.

*Danish State Railways :*

Briquettes containing soda ash, sodium phosphates and organic coagulants on the second division (Jylland and Fyen); principally soda ash with sodium phosphates and organic coagulant, and also compounds of high tannin content with poly phosphates on the first division. (Sjoelland and Falster.)

*Note :*

1. With supplies treated with lime-soda softeners simple basket feeders, made of spark-arrestor perforated plate, are used to dissolve briquettes and/or wattle tannin lumps in the treated water collecting troughs or storage tanks.

2. With supplies treated by base exchange

plant bye-pass feeders are used to dissolve tannin and fused soda ash.

3. In other cases chemicals for internal treatment, or final conditioning, are proportionately fed by :

- i) water motors and chemical pumps;
  - ii) electrically driven chemical pumps,
- or
- iii) by-pass feeders.

5) *Regulation of treatment and analysis of boiler water.*

*Aalborg Privatbaner :*

Soap test.

*Victorian Railways :*

Boiler water samples taken every 3 000 miles (4 800 km) for laboratory analysis.

*Danish State Railways :*

Regular analyses made in small laboratories at some of the more important terminals. Regular reports sent to Divisional Headquarters. Progress is towards simplification of organisation as more sources of water are treated.

*Indian Railways :*

Dosage adjusted to give a pH of 9.5 to 10.5 in the feed water.

Typical analyses of raw waters :

	<i>Parts per 100 000</i>	
	<i>Balotra</i>	<i>Pipar City</i>
Total dissolved solids	104.6	.75
Silica.....	1.6	—
Calcium carbonate ..	22.6	24.2
Magnesium sulphate	12.4	3.6
Sodium sulphate ....	23.8	12.8
Sodium chloride.....	44	32.6
Temporary hardness .	22.6	24.2
Permanent hardness .	15.1	2.1

*South African Railways :*

Samples of boiler feed water, before and after treatment, are analysed by Water Treatment Officers at eleven small laboratories situated at strategic points throughout the Railway system. Sampling varies from daily to weekly depending upon usage of the supply and capacity of treatment plants. Waters which are not treated, or emergency supplies, are sampled monthly. Samples of water from a representative number of boilers operating on each section are regularly submitted for examination.

The analyses conducted in the laboratories are :—

Total hardness (as  $\text{CaCO}_3$ ). Either soap or Versinate method. « H » reading.

Alkalinity to Phenolphthalein (as  $\text{CaCO}_3$ ). « P » reading.

Alkalinity to Methyl Orange (as  $\text{CaCO}_3$ ). « M » reading.

Caustic Alkalinity, using Barium Chloride (as  $\text{CaCO}_3$ ). « O » reading.

Chloride (Cl). Titration with Silver Nitrate. « Cl » reading.

Total dissolved solids (by conductivity). « TDS » reading.

pH (colorimetric).

Tannin (approximate). Permanganate Titration. « TAN » reading.

Phosphate («  $\text{PO}_4$  ») Colorimetric.

Annexures E.1 and E.2 show the standard form used, with typical results.

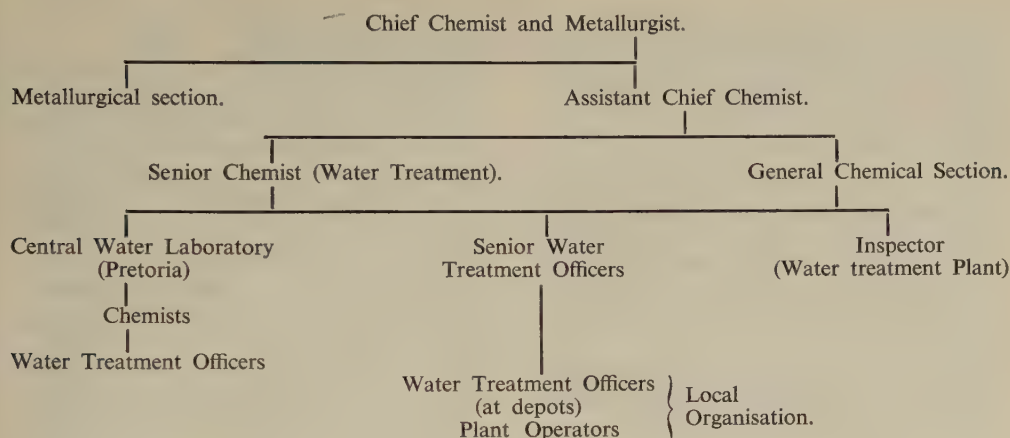
6) *Central and local organisation for controlling water treatment.*

*South African Railways :*

The organisation is depicted as follows : (see next page).

On the average each depot Water Treatment Officer controls treatment over 300 miles (480 km) of track and 100 locomotives. Seventy five per cent of all locomotives used treated water.





Depot Water Treatment Officers are responsible for operation of all plants on their sections, stocking of authorised chemicals, all boiler water analyses, other than new supplies.

There are nine systems (areas) and each system has one or more Water Treatment Officer, depending on the size. For every three systems there is a Senior Water Treatment Officer at Headquarters responsible to the Senior Chemist for correct operation of treatment processes. Fortnightly reports on standard forms are submitted to Headquarters. (Annexure E.1.)

Analyses of new water supplies, all tests of new processes and formulations, preparation and supply of water treatment chemicals are carried out by the headquarters staff under the direction of the Senior Chemist.

7) *Method of blowing down.* — *Hand operated valves or automatic continuous device.*

#### *Aalborg Privatbaner :*

Automatic continuous device linked up with production of steam.

#### *Ceylon Government Railway :*

Neckar system of blowdown operated by driver for short periods at half hour intervals.

Twenty five per cent of the Class B.1 locomotives are equipped with Everlasting blowdown valves; the blowdown technique being three short bursts of 10 seconds duration.

#### *Victorian Railways :*

Samples of boiler water are taken after each trip in certain districts, but at least every 1 000 miles (1 600 km), to determine amount of blowing down required, which is carried out only if concentration of dissolved solids is in excess of 180 grams per gallon (2 600 p.p.m.). Hand operated blowdown valves, operated from the cab, are used.

#### *Danish State Railways :*

Both hand operated valves and automatic continuous blowdown valves are used. The latter are preferred.

Amount of blowdown is 4.5 % of the water evaporated, the average hardness of which is 10-12 German degrees of hardness (180-215 p.p.m.).

#### *Indian Railways :*

Both hand operated valves and automatic continuous blowdown valves used. Hand operated valves preferred, as the orifice and the outlet pipe of the continuous blowdown valve are apt to become blocked. An average of 350-400 gallons (1 590 to 1 820

litres) are blown down on each occasion, equivalent to 15-20 % of the water evaporated per hour under average working conditions.

#### *South African Railways :*

All locomotives equipped with hand operated blowdown valves which, on the more modern locomotives, can be operated from the cab. A large number of locomotives are, in addition, equipped with hand controlled continuous blowdown through an orifice.

No devices linked with the production of steam are used and hand control is considered preferable on the score of cheaper first cost, cheapness of maintenance, ability to vary rates of blowdown to suit varying compositions of water in section, and for the fact that drivers dislike devices which they cannot control, particularly where there is danger of water shortage.

The rate of blowdown with the large hand operated blowdown valve is approximately 450 litres per minute. The rate with the constant blowdown is approximately 12 litres per minute with a 4.7 mm orifice, and 20 litres per minute with a 7.8 mm orifice (excluding 20 % flash in both cases).

8) *Periods between washouts before and after treatment.*

#### *Aalborg Privatbaner :*

Increase from seven days to six weeks.

#### *Ceylon Government Railway :*

On Class B.1 locomotives an increase from one week, where blowdown valves are not fitted, to 21 days where these valves are fitted.

#### *Victorian Railways :*

Increase from 1 000 miles (1 600 km) that is weekly, to 3 000 miles (4 800 km).

#### *Danish State Railways :*

Formerly 8 days, now extended to 90 days after the boilers have become scale free.

#### *South African Railways :*

Two examples quoted :

a) Lime-Soda-Sodium aluminate treatment plus phosphate tannin and anti-foam.

Before treatment : water change every 580 km, washout every 1 160 km;

After treatment : washout every 4 050 km (mainly necessary for renewal of fusible plugs which corrode);

b) Base exchange treatment plus tannin.

Before treatment : water change every 586 km, washout every 1 172 km;

After treatment : washout every 4 830 km.

9) *Results obtained with chemical treatment.*

#### *Sudan Railways :*

Indifferent results reported but this is accounted for by the standard of labour available and the extreme difficulty of control.

#### *Victorian Railways :*

Maintenance of firebox side sheets considerably reduced. Boiler tube renewals, previously on a two year basis, now at 4 year intervals.

#### *Danish State Railways :*

Savings experienced in maintenance and fuel. Savings in extension of washout periods alone will pay for chemicals used. Maximum period between major boiler repairs of 4 years extended to 5 years where treated water has been used for appreciable time.

#### *South African Railways :*

On one section of 500 miles (800 km), which is now fully treated, cost per mile run per boiler per general overhaul was reduced from 2.15 pence in 1949 to 1.5 pence in 1952 despite rising costs.

Steel fireboxes are standard. Trouble due to cracks and corrosion of firebox plates and stays has decreased. Boiler tube life has increased considerably and re-ending of boiler tubes at general overhaul is standard practice.

10) *Difficulties experienced as regards internal treatment.*

a) *Ebullition (priming).*

*Aalborg Privatbaner :*

Internal treatment entirely cured priming.

*Victorian Railways :*

Priming is perhaps a little more noticeable but not excessive if water is not carried too high in the boiler.

*Danish State Railways :*

Generally no trouble due to use of anti-foam.

*Indian Railways :*

Priming has been completely stopped.

*South African Railways :*

With waters that contain approximately 400 parts per million of non-incrusting solids the addition of alkalinity ( $\text{Na}^2\text{CO}^3$ ) (NaOH and phosphates), to take care of non-carbonate hardness and to render water non-corrosive, can so increase the non-incrusting solids that the upper limit can be approached and priming (foaming) result. The use of anti-foam compounds and constant, or intermittent, blowdown helps to correct this state of affairs.

b) *Scale in injectors.*

*Aalborg Privatbaner :*

Experienced to a small extent.

*Victorian Railways :*

Has not been noticed.

*Danish State Railways :*

This has been eliminated.

*South African Railways :*

Not generally experienced due to special compounds designed to delay precipitation. Wattle tannin and sodium hexameta phosphate used.

c) *Scale in pipes delivering water to boiler.*

*Aalborg Privatbaner :*

No.

*Danish State Railways :*

This has been eliminated.

*South African Railways :*

Corrective measures control this to a large extent.

11) *Formation of scale in smoke tubes where water enters boiler.*

*Aalborg Privatbaner :*

No.

*Victorian Railways :*

No.

*Danish State Railways :*

Internal treatment has diminished this phenomenon and problem is not serious.

*South African Railways :*

Proper conditioning and distribution largely prevents this.

12) *Measures adopted to combat formation of scale in smoke tubes.*

a) *Fitting of deflectors to divert jet.*

*Aalborg Privatbaner :*

Yes.

*Victorian Railways :*

Feed water is taken in on side of the barrel and diverted downwards.

*Danish State Railways :*

Yes.

*South African Railways :*

Top feed standardised. Deflection trays fitted in steam space.

b) *Use of stabilising substances to retard precipitation.*

*Aalborg Privatbaner :*

Anti-foam powder used.



*Danish State Railways :*

The chemicals used have a content of stabilising substances. Results satisfactory.

*South African Railways :*

Wattle tannin, 0.05 kg per cubic metre, and sodium hexa-metaphosphate, 2 parts per million, are used.

13) *Conclusions reached on 12 a) and b).**South African Railways :*

The stabilising substances used control the phenomenon to such a degree that no trouble is experienced with deposits in tubes. Deflection trays examined periodically and cleaned when necessary.

14) *Has above-mentioned phenomenon been noticed with all types of water**Danish State Railways :*

Scale in injectors and pipe lines has been noticed with irregular treatment of water with the analysis (in mg/l = p.p.m.) :

Dissolved solids :	574	HCO <sup>3'</sup> :	200
SO <sup>4''</sup> :	192	Cl' :	56
Total hardness :	20.6	SiO <sup>2</sup> :	12
(in German degrees)			
Permanent hardness :	11.4	pH :	7.9
(in German degrees)			

*South African Railways :*

Improperly treated hard water is the primary cause of trouble in this connection. Soft waters do not cause the trouble.

15) *Limit of salinity which should not be exceeded in boiler water.**Danish State Railways :*

No trouble experienced with salinity up to 200-300 p.p.m. Cl', when anti-foam incorporated in treatment.

*South African Railways :*

Without use of anti-foam compounds an upper limit of 3 000 parts per million of total dissolved salts in general. Actually varies with type of locomotive and nature of section.

With modern polyamide anti-foam treatment limits of 10 000 parts per million are worked to. Considered inadvisable to work to higher limits in view of possible corrosion of boiler components.

16) a) *Corrosion in water level glasses.**Aalborg Privatbaner :*

No.

*Danish State Railways :*

No serious trouble.

*South African Railways :*

Yes, with high alkalinity waters. Tests with different types of glass in hand.

b) *Corrosion in bronze valves.**Aalborg Privatbaner :*

No.

*Victorian Railways :*

Some corrosion experienced.

*Danish State Railways :*

No.

*South African Railways :*

Occasional. Traced to alloy not having been prepared and cast correctly.

c) *Corrosion in lead joints of clack valves.**Aalborg Privatbaner :*

No.

*South African Railways :*

Lead joints not used.

d) *Corrosion in fusible plugs.**Aalborg Privatbaner :*

Yes, to small extent.

*Danish State Railways :*

Yes, when pure tin was used.

*South African Railways :*

Yes, with alkaline waters, and this is

limiting factor in the extension of period between washouts.

17) *Metal used for fusible plugs.*

*Victorian Railways :*

Pure lead.

*Danish State Railways :*

« Starli » alloy with 85 % Sn, 10 % Sb and 5 % Cu. No trouble from corrosion.

*Indian Railways :*

One part tin and nine parts lead.

*South African Railways :*

Pure lead.

18) *Steps taken to prevent corrosion of fusible plugs.*

*Danish State Railways :*

Change from pure tin to « Starli » alloy.

*South African Railways :*

Use of tannin minimises alkaline attack. Plugs protected by electro-plating have

been tried out with a degree of success. Tests continuing.

19) *Economic balance sheet and comments. Type of treatment preferred.*

*Ceylon Government Railway :*

A policy of gradual dieselisation has been adopted as a solution to the water treatment problem. However, some form of treatment is to be kept to control scaling and priming.

*Danish State Railways :*

Considered that internal treatment should be extended to all water used. For water with high permanent hardness and where consumption is large, external treatment should be followed by internal treatment.

*Indian Railways :*

Treatment of the water chemically inside the boiler, the reagent being introduced into the tender, ranges in cost from 3 annas 6 pies to 1 anna 7 pies per 1 000 gallons

<i>Length of stage</i>	<i>General nature of water</i>	<i>Particulars of plant</i>	<i>Chemicals used</i>	<i>Cost per locomotive per annum</i>
160 miles (256 km.)	Upland surface water, soft. Low salinity. Hardness varying from 15 to 50 parts per million	Four electrically driven chemical pumps and chemical tanks. One water motor and chemical pump with tank. Two sets bye-pass feeders each set comprising three bye-pass feeders	Soda ash, wattle tannin, and sodium phosphate compound in briquette and powder form	£ 94 (92 200 French francs)
340 miles (544 km.)	Borehole waters. High salinity. Hardness varying from 300 to 900 parts per million	Eleven limesoda plants (Paterson type), and two base-exchange softeners	Soda ash, lime, sodium aluminate, wattle tannin, salt, phosphate compounds in briquette form and anti-foam.	£ 266. (251 000 French francs)

(approximately 4 pence to 1 3/4 pence, English).

It is intended to extend the use of « complexes » of known composition as now used in the Southern Railway and which consist of either pure tannin in the form of Quebracho extract for use with temporary hard waters or a mixture of tannin, soda ash and sodium aluminate for use with permanent hard waters.

The method favoured for introducing the reagent is from a container in the cab, connected to the feed pipe leading to the injector. It is so arranged that operating the injector lever the water and solution delivery valves are operated simultaneously.

#### *South African Railways :*

Particulars are given of a section of 500 miles (800 km) worked by 176 locomotives in which the treatment falls into two distinct categories. The cost figures include cost of chemicals, depreciation and interest on capital, and cost of plant operational wages, including the services of Water Treatment Officers (see Table on preceding page).

Corrosion and scale formation have been reduced to a bare minimum and tube and stay leakage has been considerably reduced. It is considered that the locomotives working over this section, all with steel fire-boxes and working at 225 lbs. per sq. inch (15.8 kg per sq. cm) boiler pressure would not operate successfully over this section without the full water conditioning now practised.

Since 1948 the cost of general overhauls of boilers after a set mileage has been reduced by 30 %.

\* \* \*

#### **F. LAGGING OF BOILERS.**

Asbestos mattresses for lagging boilers are in general use, the only exception being the Sudan Railways where magnesite blocks are used. In general asbestos mattresses are about 1" thick (25 mm) and consist of asbestos wool encased in woven asbestos cloth on both sides.

The Danish State Railways have tried out asbestos sheet but found this to be unsatisfactory in that the material became mouldy. The South African Railways intend to carry out tests with fibre glass mattresses.

The general practice is to wire the mattresses in place, and this refers to the magnesite blocks used by the Sudan Railways as well, and to encase the whole with steel lagging sheets fastened to crinoline frames constructed from flat steel bar, the joints in the sheets being covered with lagging bands.

It is reported that on the whole asbestos mattresses stand up fairly well to steam and hot water leaks, and the normal life of the material is reported by the various railways to vary from 10 to 20 years. The shorter range of life applies to the mattresses on the back plate, where leaks are apt to be more prevalent.

The Sudan Railways usually renew magnesite blocks at each heavy repair, approximately at three year intervals.

No information on the effect of lagging on fuel consumption, or in respect of the economic balance sheet, has been forthcoming.

The Indian Railways point out that the asbestos lagging on their boilers has been provided essentially for the comfort of the locomotive crews and extends just forward of the cab front plate, the rest of the boiler being encased only in thin steel plate, with stainless steel lagging bands. To combat radiation losses experiments are being carried out with complete insulation and it is estimated that by this means fuel savings averaging 4 % can be realised.

#### **SUMMARY.**

The use of asbestos mattresses, encased in thin steel lagging sheets, is almost general and the results in respect of insulation and life of the material are regarded as satisfactory.

\* \* \*



### G. EXHAUST.

The Victorian Railways have standardised the American Master Mechanics front end with radial ported exhaust cap. Annexure G.1 shows a typical smokebox arrangement.

On the Danish State Railways the single exhaust, with a triangular sectioned rod across the port, is most generally used, while a number of their class « E » locomotives are equipped with a double exhaust which is stated to give the same smokebox depression as the single exhaust with a lower back pressure. Annexures G.2 and G.3 show the two arrangements.

The single jet exhaust has been adopted by the Indian Railways after tests of various forms of exhaust arrangement. Annexure G.4 shows the proportions which have given good results. The blast pipe with cross spreaders is set as far forward as the design will permit and, generally, the smokebox is of the extended type and 8" to 12" (200 to 300 mm) larger in diameter than the boiler barrel, in order to obtain a uniform distribution of draught over the tubes and flues. All recently built standard locomotives, totalling 693, have been fitted with this arrangement of single jet orifice with cross spreaders (Annexure G.5).

On the South African Railways all locomotives, some 2 500 in all, are equipped with the single jet fixed area type of blast pipe cap, fitted with Goodfellow tips, or, in a few cases, cross spreaders. Annexure No. G/6 gives particulars of a self-cleaning smokebox and the proportions used, although certain of these proportions have yet to be fixed. The chimney throat area is selected to be between 3.3 % and 4.3 % of the grate area, with a preference for the higher limit. For best results the blast pipe

cap is located above the table plate and its diameter is arranged to give sealing of the steam jet in the chimney just above the throat for low back pressures, and 9 to 12 inches from the top of the chimney for high back pressures. It is reported that tests show that the steam jet spreads to 1 1/2 times the exit diameter of the nozzle immediately on leaving in and then spreads further at an incline of 1 in 12, as shown in Annexure G/6.

The Victorian Railways, the Indian Railways and the South African Railways base the design of their front ends and spark arrestors on the American Master Mechanics' design, adapted to their local conditions as the result of tests.

The Indian Railways have found that spark arrestor screens with a clear mesh not exceeding 1/4" x 3/16" (6.4 x 4.75 mm) are effective in stopping dangerous sparks without seriously obstructing the draught.

The South African Railways have for a long while been using spark arrestor plate, 3/16" (4.75 mm) thick, with apertures 7/8" x 3/16" (22.2 x 4.75 mm) giving an effective gas opening of 33 1/3 %. On recent designs of locomotives, however, it has been found necessary to use wire mesh with 3/4" x 3/16" (19.1 x 4.75 mm) apertures and a free gas opening of 49 % in order to provide the necessary gas area.

Characteristic curves for the smokebox vacuum as related to back pressure, and vaporisation corresponding to firing rate are shown in Annexures G/7 and G/8 (Indian Railways) and Annexures G/9, G/10 and G/11 (South African Railways).

The last mentioned Railways give the maximum combustion rates for their classes 19D and 23 locomotives as :—

Class	Weight of coal kg per sq. m.	Burnt per hour lb. per sq. foot.	Rate of actual evaporation	
			kg/hour	lbs/hour
19D Hand fired .....	550	115	13 600	30 000
23 Stoker fired .....	830	170	21 600	47 500

## SUMMARY.

No trials of exhaust systems of advanced design are reported and the conventional type of exhaust system is in almost general use, the endeavour to obtain exhaust efficiency and distribution of draught over the tube plate being more confined to smoke-box proportions and the relative positioning of the blast pipe cap.

\* \* \*

## H. DISTRIBUTION.

No Railways report any improvements of note in the construction of pistons and valves.

With regard to the type of valve gear preferred all the Railways replying to the questionnaire express a preference for the Walschaert valve, with piston valves, giving such factors as simplicity, accessibility, and comparatively low maintenance costs in support of the choice.

Although figures are not given it would appear from the replies that the greater proportion of the locomotives on the Railways concerned are equipped with Walschaert valve gear and piston valves, and that the arrangement has been standardised for future locomotives.

The Indian Railways state that dynamometer car tests have clearly proved the greater steam economy obtainable at early cut offs with modern poppet valve gears as compared with the longest lap piston valve gears. It has also been found that maintenance has generally been lower with the former. Despite these points, however, practical considerations have led these Railways to standardise long lap piston valves with Walschaert gear on new locomotives.

On the South African Railways classes 15E, 16E, 19C and 20, totalling 101 locomotives in all, are equipped with R.C. poppet valve gear. It is reported that not only are maintenance costs higher than with Walschaert gear and piston valves but the attention required by the gear affects the availability of the locomotives. This differs from the reported experience of the Indian Railways.

Apart from the 101 locomotives mentioned above, and a comparatively small number of obsolescent locomotives with Stephenson link motion and slide valves, by far the greater proportion of locomotives on the South African Railways are equipped with Walschaert gear and piston valves.

The following characteristics of piston valves are given by the Railways referred to :

	South African Railways		Indian Railways
	Class 23	Class GM.	Class WP.
Cylinder dia. . . . .	24" (610 mm)	20 1/2" (521 mm)	20 1/4" (514 mm)
Valve dia. . . . .	11 1/2" (292 mm)	11" (279 mm)	12" (305 mm)
Lead . . . . .	13/64" (5 mm)	1/8" (3 mm)	1/4" (6 mm)
Steam lap. . . . .	1 1/2" (38 mm)	1 5/8" (41 mm)	1 11/16" (43 mm)
Valve travel in full gear . . .	7 1/2" (191 mm)	6 9/16" (167 mm)	7 3/4" (197 mm)

The Indian Railways point out that earlier experiments on a previous locomotive (BESA), with 12" (305 mm) valves having 1/4" (6 mm) lead and 1 7/8" (48 mm) lap, showed that mechanical vibra-

tions were induced in the reversing gear due to the inertia of the valves but these vibrations were largely overcome by reducing the steam lap to 1 11/16" (43 mm), which is now regarded as a practical limit.

Appendix H/1 shows comparative steam rates for 3/16" and 1/4" leads (5 and 6 mm) with piston valves operated by Walschaert gear, and Appendix H/2 shows comparative steam consumption with different valve gears.

No Railway System reports having had experience with conjugated and independent valve gears, but the Victorian Railways do not favour such gears on the score of the extra maintenance involved.

No reports on trials with special valve gears have been received.

The Indian Railways in summing up the advantages and disadvantages of the three types of valve gear, viz. ordinary piston valves, valves with rotary cams, and the Caprotti valve gear, draw the conclusion that, from practical considerations, long lap piston valves operated by Walschaert gear are best suited to their requirements despite the fact that the other two types of valve gear have the advantage of a good steam cycle at specific cut offs and show economies over the piston valve gear at early cut offs.

#### SUMMARY.

No interesting improvements in distribution have been reported.

Although it is conceded that poppet valves operated by cam gear have advantages over piston valves operated by Walschaert gear, particularly in respect of freedom of bye-passing and economy in steam consumption at early cut-offs, all Railways reporting on this item have adopted piston valves operated by Walschaert gear as standard, primarily from practical consideration embracing such factors as simplicity, accessibility and ease of maintenance.

\* \* \*

#### I. VARIOUS.

##### a) *Condenser for exhaust steam.*

Only the South African Railways reported on this item.

A Henschel condensing tender was fitted

to a class 20 locomotive for experimental purposes. This class of locomotive has a tractive effort of 33 080 lbs. at 75 % boiler pressure (approximately 15 000 kgs) and 4' - 0" diameter coupled wheels (1.22 m).

It is reported that the condenser was able to cope with the exhaust steam at the highest evaporative capacity of the boiler, which was 13 000 kg/hour. Under test it was found that the water consumption ranged from 7 % to 13 % of that of a corresponding non-condensing locomotive under the same conditions, depending on the steam leakages occurring, giving a working range of 400-700 miles (640-1 100 km) depending on the type of section and load. The saving in coal ranged from 7 % at low firing rates to 16 % at high firing rates.

As a result of these tests the South African Railways have ordered 90 class 25 locomotives with condensing tenders for main line work. The class 25 locomotive has a tractive effort of 45 360 lbs. (20 600 kg) at 75 % boiler pressure and coupled wheels 5' - 0" (1.52 m) in diameter, and the locomotives will be worked over a section where difficulties have been experienced due to inadequate water supplies.

The Danish State Railways consider that the equipment is too complicated.

##### b) *The circulation of water in the boiler.*

The Indian Railways consider that circulating devices such as thermic syphons, security arch tubes, or circulation tubes, etc. are necessary to a limited extent in locomotive boilers. They point out that extensive application of such devices increases heat absorption in the firebox, but tends to reduce the superheat temperature, and have the advantages of cutting down the lighting up time, increasing the boiler efficiency, and minimising strains set up in various parts of the boiler. There is the disadvantage of a reduction of accessibility in the firebox for routine maintenance. The employment of such devices calls for the use of treated water and proper maintenance in the interests of safety from explosion.



On the South African Railways two classes of Garratts, the GM totalling 16 locomotives and the GL totalling 8 locomotives, are equipped with thermic syphons. All standard boilers, totalling 1 440, are equipped with arch tubes, while the new class 25 locomotives, 140 in all, will be equipped with security arch tubes.

c) *Steam circuits.*

Although several Railway administrations indicate their appreciation of well designed steam circuits to minimise pressure drop,

the Indian Railways add the following information :

In the new Indian standard locomotives the minimisation of pressure drop has been achieved by planning the throttle valve of ample size, large diameter internal steam pipe, sufficient flow cross section through the superheater elements so as to restrict the steam velocity to 3 000 feet per second (914 metres per second), and large capacity branch steam pipes.

The relevant particulars of the classes WP, WG, YP, and YG locomotives are as follows :

	WP.	WG.	YP.	YG.
Throttle valve diameter	9 5/8" (24.5 cm)	9 5/8" (24.5 cm)	8 5/8" (21.9 cm)	8 5/8" (21.9 cm)
Diameter of internal steam pipe. . . . .	7" (17.8 cm)	7" (17.8 cm)	6" (15.24 cm)	6" (15.24 cm)
Flue connection through elements . . . . .	43.8 sq. in. (282 sq. cm)	43.8 sq. in. (282 sq. cm)	26.7 sq. in. (172 sq. cm)	26.7 sq. in. (172 sq. cm)
Capacity of each branch steam pipe. . . . .	2.14 c. ft. (60.4 litres)	2.14 c. ft. (60.4 litres)	1.3 c. ft. (36.7 litres)	1.3 c. ft. (36.7 litres)
Piston swept volume per cylinder . . . . .	5.75 c. ft. (162.5 litres)	6.68 c. ft. (189 litres)	2.79 c. ft. (78.7 litres)	3.16 c. ft. (89.2 litres)
Capacity of each branch pipe				
	.372	.320	.466	.38
Piston swept volume per cylinder.				

d) *Preheating the air.*

No Administration reports experience of preheating the air.

e) *Compounding the engine.*

The Danish State Railways report that they experience better fuel economy with their compound locomotives, classes E and P, than with single expansion locomotives. The compound locomotives are, however,

rather complicated and have a higher maintenance cost. They conclude that were new locomotives to be provided today they would probably choose the single expansion type (with a boiler pressure of 18 kg/sq. cm and a high superheat) in view of the simpler construction.

Experience with compound locomotives on the Indian Railways is limited and in spite of the normal advantages of com-

pound expansion such design is not generally favoured owing to excessive maintenance involved with the provision of crank axles and inside cylinders. This Administration stresses that engine availability is a prime factor and it is generally the opinion that use of compound engines on locomotives restrict the availability of the locomotives as compared with single expansion engines.

f) *Stream lining locomotives.*

The Victorian Railways have four partly stream lined locomotives but consider the streamlining of no practical value. The Danish State Railways and the South African Railways do not consider streamlining necessary with the maximum speeds in use, 120 and 88 km per hour, respectively.

The Indian Railways are not favourably disposed to streamlining owing to the resultant inaccessibility of parts that require constant attention.

## SUMMARY.

a) *Condensers for exhaust steam.*

Only one Administration, the South African Railways, show interest in this and will shortly place 90 condenser locomotives in service, primarily on account of inadequate water supplies of poor quality.

b) *The circulation of water in boilers.*

One Administration, the South African Railways, report having a large number of arch tubes and lesser numbers of thermic syphons and security arch tubes fitted and make no mention of any disadvantages.

c) *Steam circuits.*

Administration replying to this point appreciate the advantages of well designed steam circuits and the Indian Railways give certain data regarding their modern standard locomotive.

d) *Preheating the air.*

No Administration reports experience with preheating air.

e) *Compounding the engine.*

Compounding is adversely criticised because of greater complication with resultant higher maintenance costs.

f) *Streamlining the locomotive.*

Streamlining is favoured by none of the Administrations either because the maximum speeds do not warrant it or because of the resultant inaccessibility of parts requiring constant attention.

\* \* \*

## PRESENT LOCOMOTIVE STOCK AND FUTURE TRENDS.

The Aalborg Privatbaner has changed completely to diesel traction and rail cars. Steam locomotives are only being retained in reserve in case of snow difficulties.

The Sudan Railways have 124 oil fired main line steam locomotives.

The Victorian Railways at present has a stock of 609 steam locomotives and ten diesel electric shunting locomotives. In the near future 26 main line diesel electric locomotives and 25 main line electric locomotives are to be procured, and a considerable decrease in the use of steam traction over the next ten years is foreseen.

The stock of locomotives and rail cars on the Danish State Railways is as follows :

Steam locomotives for road service . .	402
Diesel locomotives for road service . .	8
Diesel electric rail cars . . . . .	118
Petrol engined rail cars . . . . .	17
Articulated trains (diesel electric) . .	8
Straight electric rail cars . . . . .	102

The policy to be followed in the future by this Administration is at present being investigated.

The Indian Railways had the following power as at 31st March, 1951 :—

Steam locomotives . . . . .	8 120
Diesel electric shunters . . . . .	17
Electric locomotives . . . . .	72

## L - Utilisation and maintenance

RAILWAY SYSTEM	INDIAN RAILWAYS			
GAUGE . . . . .	5' - 6" (1.68 m)	3' - 3 3/8" (1.0 m)	5' - 6" (1.68 m)	3' - 3 3/8" (1.0 m)
Class of locomotive . .	WP.	YP.	WG.	YG.
Type of locomotive. . .	Standard passenger and express	Standard passenger and express	Standard goods locomotive	Standard goods locomotive
Number of locomotives .	316	78	149	150
Average annual mileage per locomotive . . . .	59 000 miles 94 950 km (see note 1)	47 000 miles 75 640 km (see note 1)	34 000 miles 54 720 km (see note 1)	32 000 miles 51 500 km (see note 1)
Tractive effort . . . . .	30 600 lbs. at 85 % B.P. (13.88 metric tons)	18 400 lbs. at 85 % B.P. (8.34 metric tons)	38 890 lbs. at 85 % B.P. (17.6 metric tons)	23 450 lbs. at 85 % B.P. (10.63 metric tons)
Single crew, multiple crew or common usage . . .	Multiple crews and common usage	Multiple crews and common usage	Multiple crews and common usage	Multiple crews and common usage
Maximum distance between locomotive changes	475 miles (765 km)	—	—	—
Maximum distance between stops . . . . .	126 miles (203 km)	—	—	—
Tonnage hauled . . . . .	540 tons (average)	360 tons (average)	2 100 tons on level 1 450 tons on 1 : 150 (see note 2)	1 450 tons on level 660 tons on 1 : 150 (see note 2)
Profile of line . . . . .	Ruling gradients generally vary from 1 in 80 to 1 in 300 Mileage of graded sections, steeper than 1 in 80, is very small compared to total route mileage			
Maximum speed . . . . .	60 m.p.h. 96 km/hr.	50 m.p.h. 80 km/hr.	45 m.p.h. 72 km/hr.	30 m.p.h. 48 km/hr.
Average speed . . . . .	30-35 m.p.h. 48-56 km/hr.	20-25 m.p.h. 32-40 km/hr.	12 m.p.h. 19 km/hr.	10.2 m.p.h. 16 km/hr.
Maintenance costs per kilometre, in pence (Engl.) and French francs; SHOPS . . . . . SHEDS . . . . . Total . . . . .	(see note 3)			



p-to-date locomotives

## SOUTH AFRICAN RAILWAYS

3' - 6" (1.067 m)	3' - 6" (1.067 m)	3' - 6" (1.067 m)	3' - 6" (1.067 m)	3' - 6" (1.067 m)
23	15F	19D	GM (Garratt)	24
Main line. Passenger & goods: 96 lbs. track (47.8 kg/m)	Main line. Passenger & goods: 80 lbs. track (40.0 kg/m)	Branch line. Passenger & goods: 60 lbs. track (30 kg/m)	Branch line. Passenger & goods: 60 lbs. track (30 kg/m)	Branch line Passenger & goods: 45 lbs. track (20.25 kg/m)
136	255	235	16	100
61 000 miles 98 170 km	52 000 miles 83 690 km	48 000 miles 77 250 km	48 000 miles 77 250 km	47 000 miles 75 640 km
43 200 lbs. at 75 % B.P. (19.6 metric tons)	42 430 lbs. at 75 % B.P. (19.2 metric tons)	31 850 lbs. at 75 % B.P. (14.45 metric tons)	60 700 lbs. at 75 % B.P. (27.5 metric tons)	27 600 lbs. at 75 % B.P. (12.5 metric tons)
Common usage	Common usage	Common usage	Common usage	Common usage
910 miles (1 465 km)	—	—	—	—
101 miles (162 km)	—	—	—	—
600 short tons 430 English tons	1 510 short tons 1 348 English tons	950 short tons 850 English tons	1 290 short tons 1 150 English tons	840 short tons 750 English tons
Ruling gradient: 1 : 100 Sharpest curve: 1 320 feet	Ruling gradient: 1 : 100 Sharpest curve: 950 feet	Ruling gradient: 1 : 80 Sharpest curve: 1 320 feet	Ruling gradient: 1 : 60 Sharpest curve: 660 feet	Ruling gradient: 1 : 100 Sharpest curve: 660 feet
60 m.p.h. 96 km/hr.	55 m.p.h. 88 km/hr.	45 m.p.h. 72 km/hr.	45 m.p.h. 72 km/hr.	25 m.p.h. 40 km/hr.
—	—	—	—	—
7.75 pence 27.6 francs 4.48 pence 18.3 francs 2.23 pence 45.9 francs	5.55 pence 22.7 francs 4.5 pence 18.4 francs 10.05 pence 41.1 francs	3.6 pence 14.7 fr. 3.4 pence 13.9 fr. 7.0 pence 28.6 fr.	6.2 pence 25.3 fr. 5.7 pence 23.3 fr. 11.9 pence 48.6 fr.	2.05 pence 8.3 fr. 4.2 pence 17.2 fr. 6.25 pence 25.5 fr.

**L - Utilisation and maintenance of up-to-date locomotives (continued).**

RAILWAY SYSTEM	VICTORIAN RAILWAYS		SUDAN RAILWAYS
GAUGE . . . . .	5' - 3" (1.60 m)	5' - 3" (1.60 m)	3' - 6" (1.067 m)
Class of locomotive . .	R	N	—
Type of locomotive . . .	Passenger	Goods	Mixed traffic
Number of locomotives .	70	73	124
Average annual mileage per locomotive . . . .	36 000 miles 58 000 km	24 000 miles 39 000 km	30 000 miles 48 000 km
Tractive effort . . . . .			
Single crew, multiple crew or common usage . . .	Common usage	Common usage	Double crews completely pooled
Maximum distance between locomotive changes	100 miles (160 km) Isolated cases of 200 miles (320 km) with S type loco	100 miles (160 km)	430 miles 692 km
Maximum distance between stops . . . . .	200 miles (320 km) with S type loco	—	55 miles 88 km
Tonnage hauled . . . . .	385 tons on 1 in 50	390 tons on 1 in 50	639 tons
Profile of line . . . . .	—	—	—
Maximum speed . . . . .	70 m.p.h. 112 km/p.h.	45 m.p.h. 72 km/p.h.	—
Average speed . . . . .	—	—	—
Maintenance costs per kilometre, in pence (English) and French francs: SHOPS . . . . . SHEDS . . . . . Total . . . . .	18 pence — 73.6 francs		

**NOTES ON UTILISATION AND MAINTENANCE OF UP-TO-DATE LOCOMOTIVES**

*Note 1.* Since the average annual mileage figures for the actual classes of locomotives given in the table are not available the Indian Railways have quoted figures for broad gauge passenger, medium gauge passenger, broad gauge goods and medium gauge goods locomotives.

*Note 2.* The tonnages hauled by classes WG. and YG. (Indian Railways) on 1 in 150 grades are with favourable approach to the gradient.

*Note 3.* Against « Maintenance Cost » the Indian Railways were not able to give figures for each individual type of locomotive, but for the average of all locomotives on the line give the following figures :

Maintenance cost per locomotive per kilometre :	Shop	Shed	Total	Shop	Shed	Total
pence . . . . .	3.87	2.88	6.75	2.88	2.26	5.14
French francs . . . . .	15.8	11.75	27.55	11.75	9.25	21.0
	(broad gauge)			(medium gauge)		

RAILWAY ADMINISTRATION		INDIAN RAILWAYS		SOUTH AFRICAN RAILWAYS			RAILWAYS
Classes of Locomotives		Classes WP/WG.		Class 23 (stoker fired)		Class 23 (hand fired), Class 15 F.	Class R.
Firing rate :		Maximum	2/3 Maximum	Maximum	2/3 Maximum	Maximum	Maximum
Pounds per hour . . . .		4 500	3 000	10 700	7 134	8 190	5 200
(Kg. per hour) . . . . .		2 040	1 360	4 850	3 235	3 715	2 360
Pounds per sq. ft. hr. . .		98	65.2	170	115	130	130
Kg. per sq. m. hr. . . .		478	318	828	561	635	635
Steam production :							
Weight per hour — pounds.		22 000	15 000	47 000	38 500	46 500	35 660
(kilogrammes) . . . . .		10 000	6 800	21 300	17 460	21 100	16 200
Weight per unit of heating surface per hour :							
Pounds per sq. ft. . . .		7.5	5.12	13.9	11.4	13.8	15.9
Kg. per sq. m. . . . .		36.7	24.9	67.9	55.6	67.3	77.6
Ratio between weight of water evaporated and coal burnt. . . . .		4.9	5.0	4.39	5.40	5.66	7.94 - 8.88
Superheat temperature . . .		In header 700°F (371°C)		695°F (369°C)	675°F (355°C)	685°F (363°C)	Average 650°F (342°C) Maximum 740°F (394°C)
Indicated and effective horse power in terms of speed and admission . . . . .		Annexure M/3					Max.Cyl.H.P 1890 at 39 M.P.H. and 12" cut off.
Efficiency of the engine (In terms of horse power dissipated) . . . . .		Annexure M/4					
Total indicated and effective horse power. . . . .		Annexure M/2			Annexure B/9.		
Coal and water per I.H.P./hr. and E.H.P./hr. . . . .		Annexure M/2			Annexure M/1.		
Characteristics of coal used		Annexure A/11			Annexure A/11. (Transvaal coal)		11 900 B.T.U./lbs.



The future developments in India are likely to be :

a) electrification of certain lines with dense traffic;

b) electrification of suburban services around Calcutta;

c) extended use of diesels for shunting, and

d) greater use of diesels on narrow gauge hill sections with sharp curvature. In spite of these developments the Administration considers that steam locomotives will provide 85 % of the traction for the next 20 years.

The position on the South African Railways is as follows :—

	Number in service.	Number on order.
Steam locomotives . .	2 506	260
Electric locomotives . .	236	89
Diesel locomotives . .	2	—

#### SUMMARIES.

The following general summaries have been drawn from the replies to the questionnaire received from the various Railway Administrations :—

1) The period 1937 to 1953 has not been marked by any important advances in locomotive design. On the whole the approach to locomotive problems has been conservative with the emphasis on reliability, in order to increase availability, and simplicity with the object of keeping maintenance costs down.

2) Steam pressures show no marked increase, either in general or in particular cases, and consequently there has been no adoption of special steels for boiler plates. The conventional type of boiler has been adhered to and no special designs have been produced.

3) Most Railways have arrived at as large air openings through fire grates as possible, consistent with strength and avoid-

ance of unburnt fuel falling through the openings. Where coal of small size is used, particularly in the case of mechanical firing pinhole, honeycomb and « slotted » types of grates have been developed.

4) In certain cases special attention has been directed to the design and proportions of brick arches.

5) Despite the fact that mechanical stokers are wasteful of coal, as compared with hand firing, certain Railways have adopted them in the case of their larger locomotives which are beyond the physical capacity of firemen to fire at their maximum boiler output. Mechanical stokers are also specifically useful in order to handle slack and small coal.

6) With one exception of a Railway strategically situated for its use, oil is generally not favoured on economic grounds.

7) The approach to higher superheat temperatures has been conservative and there has been no marked increase. In general 700° F (371° C) is considered to be a workable maximum.

8) There have been no advances in the design of superheater elements. The (A) type element, with four passes in the flue tube, is in general use.

9) Cast iron piston and valve rings are used almost exclusively. In the case of two Railways the segmental type ring, of cast iron and bronze segments, is used to a certain extent. There is little uniformity in the types of piston and valve rod packing used.

10) The practice of preheating the boiler feed water has declined since 1937, primarily on the score that maintenance required by the appliances outweighs the increase in boiler efficiency.

11) Good progress has been made in the treatment of boiler feed water and all Railways reporting on this matter have gained an increased availability of locomotives and lessened boiler maintenance. Water condi-

Railway company	PARTICULARS OF SUPERHEATED LOCOMOTIVE BOILERS. ANNEXURE No. 2.																			GENERAL CHARACTERISTICS OF LOCOMOTIVES — ANNEXURE No. 1.												
	Class of locomotive	Type of locomotive	Year of construction or rebuilding	Number of locomotives	Boiler pressure	Grate area	Total heating area	Superheating area	Tubes			Weight of the boiler empty	Weight of the boiler per m <sup>2</sup> of total heating area	Type of firebox	Nature and chief characteristics of the metal used for the plates				Type of locomotive	Cylinders			Piston stroke	Type of valve gear	Diameter of coupled wheels	Maximum speed	Theoretical tractive effort at tender drawbar	Formula used for calculating tractive effort	Service worked			
									Superheater	Boiler					Length	Firebox	Combustion chamber	Smokebox		Barrel	High pressure	Low pressure								Diameter		
										Dia	No																				Dia	No
South African Railways	24.	2 : 8 : 4	1948	100	200 lb./sq. in. 14.08 kg./cm <sup>2</sup>	36 sq. ft. 3.34 m <sup>2</sup>	1 636 sq. ft. 151.9 m <sup>2</sup>	380 sq. ft. 35.3 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	24	2 1/2" O.D. 63.5 mm	76	17'-9" 5 410 mm	24 ton 4 cwt. 2 qr. 24 600 kg	165 kg	Round top	Steel sym. 10	—	Steel sym. 6	Steel sym. 6	Simple expansion	2 outs.	—	1'-7" 482.6 mm	2'-2" 660.4 mm	Walschaert	4'-3" 1.29 m	45 m.p.h. 72.4 km per h	27 600 lbs. 12 520 kg	$T.E. = \frac{P \cdot D \cdot S}{W} \times C$	General purpose	
	23.	4 : 8 : 2	1938	136	225 lb./sq. in. 15.84 kg./cm <sup>2</sup>	63 sq. ft. 5.85 m <sup>2</sup>	3 400 sq. ft. 315.8 m <sup>2</sup>	676 sq. ft. 62.8 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	36	2 1/2" O.D. 63.5 mm	136	22'-6" 6 858 mm	33 ton 5 cwt. 3 qr. 34 000 kg	106.2 kg	»	»	»	»	»	2 »	—	2'-0" 609.6 mm	2'-4" 711.2 mm	»	5'-3" 1.6 m	55 m.p.h. 88.5 km per h	43 200 lbs. 19 595 kg	Where : P = 75 % Boiler pressure	»		
	19D.	4 : 8 : 2	1948	235	200 lb./sq. in. 14.08 kg./cm <sup>2</sup>	36 sq. ft. 3.34 m <sup>2</sup>	1 839 sq. ft. 170.8 m <sup>2</sup>	390 sq. ft. 36.2 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	24	2 1/2" O.D. 63.5 mm	76	20'-2" 6 146 mm	27 ton 4 cwt. 2 qr. 27 800 kg	164.5 kg	»	»	»	»	»	2 »	—	1'-9" 533.3 mm	2'-2" 660.4 mm	»	4'-6" 1.37 m	45 m.p.h. 72.4 km per h	31 850 lbs. 14 447 kgs.	S = Stroke in ins.	»		
	15E.	4 : 8 : 2	1935	44	210 lb./sq. in. 14.79 kg./cm <sup>2</sup>	48 sq. ft. 4.45 m <sup>2</sup>	2 777 sq. ft. 257.9 m <sup>2</sup>	716 sq. ft. 66.5 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	36	2 1/2" O.D. 63.5 mm	136	22'-6" 6 858 mm	32 ton 15 cwt. 1 qr. 33 400 kg	132 kg	»	»	»	»	»	2 »	—	2'-0" 609.6 mm	2'-4" 711.2 mm	R.C. Poppet	5'-0" 1.52 m	55 m.p.h. 88.5 km per h	42 340 lbs. 19 205 kg	W = dia. of driving wheels in ins.	»		
	15F.	4 : 8 : 2	1949	225	210 lb./sq. in. 14.79 kg./cm <sup>2</sup>	63 sq. ft. 5.85 m <sup>2</sup>	3 400 sq. ft. 315.8 m <sup>2</sup>	676 sq. ft. 62.8 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	36	2 1/2" O.D. 63.5 mm	136	22'-6" 6 858 mm	32 ton 15 cwt. 1 qr. 33 400 kg	103 kg	»	»	»	»	»	2 »	—	2'-0" 609.6 mm	2'-4" 711.2 mm	Walschaert	5'-0" 1.52 m	55 m.p.h. 88.5 km per h	42 340 lbs. 19 205 kg	C = Constant =	»		
	G.E.A.	4:8:2-2:8:4	1946	50	200 lb./sq. in. 14.08 kg./cm <sup>2</sup>	51.3 sq. ft. 4.73 m <sup>2</sup>	2 540 sq. ft. 235.9 m <sup>2</sup>	470 sq. ft. 43.6 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	36	2" O.D. 50.8 mm	282	11'-8 3/8" 3 566 mm	26 ton 3 cwt. 1 qr. 26 400 kg	113 kg	»	»	»	»	»	4 »	—	1'-6 1/2" 469.9 mm	2'-2" 660.4 mm	»	4'-0" 1.21 m	45 m.p.h. 72.4 km per h	55 620 lbs. 25 229 kg	1 for simple 2 cyl. engs.	Shunting		
	G.M.	4:8:2-2:8:4	1938-1939	16	200 lb./sq. in. 14.08 kg./cm <sup>2</sup>	64 sq. ft. 5.94 m <sup>2</sup>	3 066 sq. ft. 284.8 m <sup>2</sup>	778 sq. ft. 72.3 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	50	2" O.D. 50.8 mm	255	13'-6 1/2" 4 127 mm	31 ton 8 cwt. 0 qr. 31 950 kg	94 kg	»	»	»	»	»	4 »	—	1'-8 1/2" 520.7 mm	2'-2" 660.4 mm	»	4'-6" 1.37 m	45 m.p.h. 72.4 km per h	60 700 lbs. 27 533 kg	1.5 for simple 3 cyl. engs.	»		
	S.1.	0 : 8 : 0	1947	12	180 lb./sq. in. 12.68 kg./cm <sup>2</sup>	42 sq. ft. 3.9 m <sup>2</sup>	1 820 sq. ft. 169.0 m <sup>2</sup>	428 sq. ft. 39.8 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	30	2" O.D. 50.8 mm	151	13'-2 11/16" 4 030 mm	30 ton 11 cwt. 2 qr. 31 000 kg	182.5 kg	»	»	»	»	»	2 »	—	1'-11 1/4" 590.5 mm	2'-1" 635 mm	»	4'-0" 1.21 m	25 m.p.h. 40.2 km per h	38 000 lbs. 17 237 kg	2 for simple 4 cyl. engs.	General purpose		
	S.2.	0 : 8 : 0	1952-1953	100	195 lb./sq. in. 13.73 kg./cm <sup>2</sup>	30 sq. ft. 2.78 m <sup>2</sup>	1 092 sq. ft. 101.4 m <sup>2</sup>	330 sq. ft. 30.6 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	30	2" O.D. 50.8 mm	91	13'-3 5/8" 4 054 mm	15 ton 10 cwt. 2 qr. 15 750 kg	160 kg	»	»	»	»	»	2 »	—	1'-6" 457.2 mm	2'-2" 660.4 mm	»	4'-0" 1.21 m	25 m.p.h. 40.2 km per h	25 600 lbs. 11 612 kg		»		
	S	4 : 8 : 4	1953-1954	140	225 lb./sq. in. 15.84 kg./cm <sup>2</sup>	69 sq. ft. 6.41 m <sup>2</sup>	2 510 sq. ft. 233.1 m <sup>2</sup>	680 sq. ft. 63.1 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	43	2 1/2" O.D. 63.5 mm	83	19'-0" 5 791 mm	36 ton 7 cwt. 0 qr. 37 000 kg	160 kg	»	»	»	»	»	2 »	—	2'-0" 609.6 mm	2'-4" 711.2 mm	»	5'-0" 1.52 m	55 m.p.h. 88.5 km per h	42 340 lbs. 19 205 kg		»		
G.O.	4:8:2-2:8:4	1953-1954	25	200 lb./sq. in. 14.08 kg./cm <sup>2</sup>	54 sq. ft. 5.02 m <sup>2</sup>	2 761 sq. ft. 256.5 m <sup>2</sup>	600 sq. ft. 55.7 m <sup>2</sup>	5 1/2" O.D. 139.7 mm	36	2 1/4" O.D. 57.2 mm	180	11'-8 5/8" 3 572 mm	24 ton 3 cwt. 0 qr. 24 600 kg	96 kg	»	»	»	»	»	4 »	—	1'-6 1/2" 469.9 mm	2'-2" 660.4 mm	»	4'-6" 1.37 m	45 m.p.h. 72.4 km per h	49 400 lbs. 22 407 kg		»			
Danish State Railways	E.	4 : 6 : 2	1948	36	13 kg./cm <sup>2</sup>	3.60 m <sup>2</sup>	184.7 m <sup>2</sup>	63.64 m <sup>2</sup>	125 mm I.D.	28	45.5 mm	154	5 367 mm	27 000 kg	146 kg	—	—	—	—	Compound expansion	2 ins.	2 ext.	H.P. 420 mm L.P. 630 mm	H.P. 660 mm L.P. 660 mm	»	1.896 m	110 km per h	19 845 lbs. 9 000 kg	—	Passenger & goods		
	H.	2 : 8 : 0	1941	17	12 kg./cm <sup>2</sup>	2.62 m <sup>2</sup>	161.0 m <sup>2</sup>	55.0 m <sup>2</sup>	125 mm I.D.	28	45.5 mm	133	4 868 mm	23 000 kg	143 kg	»	—	—	—	»	1 ins.	2 ext.	H.P. 470 mm L.P. 470 mm	H.P. 670 mm L.P. 670 mm	»	1.404 m	80 km per h	27 122 lbs. 12 300 kg	$T.E. = 0.975 \frac{p \cdot d^3}{D}$ p = press. in kg/cm <sup>2</sup> d = cyl. dia. in cm D = Driving wheel dia. in cm.	Goods service		
Ceylon Government Railway	A.3-A.3D	4 : 8 : 0	1951	15	180 lb./sq. in. 12.68 kg/cm <sup>2</sup>	23.5 sq. ft.	979 sq. ft. 90.9 m <sup>2</sup>	252 sq. ft. 23.4 m <sup>2</sup>	5 1/8" 130.1 mm	18	2" 50.8 mm	80	13'-1" 3 987 mm	—	—	Round top	M.S.	M.S.	M.S.	M.S.	Simple expansion	2 ext.	—	1'-5" 431.8 mm	1'-10" 558.8 mm	»	4'-0" 1.21 m	50 m.p.h. 80.4 km per h	18 000 lbs. 8 164 kg	$T.E. = \frac{D^2 \cdot S \cdot P}{W}$	Mixed traffic	
	B.1-B.1E	4 : 6 : 0	1948	49	160 lb. sq. in. 11.24 kg/cm <sup>2</sup>	26.1 sq. ft.	1 180 sq. ft. 109.6 m <sup>2</sup>	160 sq. ft. 14.8 m <sup>2</sup>	5 1/8" 130.1 mm	18	2" 50.8 mm	117	12'-5 3/4" 3 803 mm	—	—	Belpaire	»	»	»	»	2 »	—	1'-6 1/2" 469.9 mm	2'-2" 660.4 mm	»	4'-5 1/2" 1.35 m	55 m.p.h. 88.5 km per h	21 663 lbs. 9 826 kg	Where: D = cyl. dia. in ins. S = stroke in. ins.	»		
	C.1A	2:6:2-2:6:2	1946	8	185 lb./sq. in. 13.01 kg/cm <sup>2</sup>	44.9 sq. ft.	1 860 sq. ft. 172.8 m <sup>2</sup>	362 sq. ft. 33.6 m <sup>2</sup>	5 1/8" 130.1 mm	32	2" 50.8 mm	191	11'-7 3/8" 3 540 mm	—	—	»	»	»	»	»	4 »	—	1'-4" 406.4 mm	1'-10" 558.8 mm	»	3'-7" 1.09 m	52 m.p.h. 83.6 km per h	38 436 lbs. 17 434 kg	P = M.E.P. per sq. in. of pist. W = dia. of dr. wheels in ins.	»		
Indian Railways	W.P. W.G.	4 : 6 : 2 2 : 8 : 2	1947-1949 1950-1952	316 149	14.75 kg./cm <sup>2</sup>	4.28 m <sup>2</sup>	271 m <sup>2</sup>	63.5 m <sup>2</sup>	139.7 mm O.D.	33	57.2 mm O.D.	118	4 841.4 mm	25 500 kg	94.1 kg	Round top	Steel to I.R.S. spec. R. 29.	Steel to I.R.S. spec. R. 29.	Steel to I.R.S. spec. M.S. class 1L.	Steel to I.R.S. spec. class V.M.6 (R.2)	»	2 ext.	—	W.P. 1'-8 1/4" 514 mm W.G. 1'-9 1/8" 536.6 mm	W.P. 2'-4" W.G. 2'-4"	»	W.P. 5'-7" - 1.7 m W.G. 5'-1 1/2" - 1.55m	—	W.P. 30 600 lbs. 13 878 kg W.G. 38 890 lbs. 17 640 kg			





tions vary widely and there is little uniformity in methods of treatment.

12) Asbestos mattresses, encased in thin steel plate, are used almost exclusively for lagging boilers.

13) The conventional type of single ported, fixed area, blast pipe, usually equipped with some form of spreader, is in almost general use. No trials of advance design of exhaust system have been reported. Endeavours to improve exhaust efficiency have been directed towards improving smokebox proportions and the positioning of the blast pipe cap.

14) Piston valves operated by Walschaert gear are strongly favoured on the score of simplicity, accessibility, and ease of maintenance.

15) Only one Railway Administration has reported on trials with a condensing tender locomotive, and on the strength of these trials is obtaining 90 main line loco-

motives so equipped for use on a section where water supplies are inadequate.

16) Two Railways report on the efficacy of water circulating devices such as arch tubes and thermic syphons. One of these Railways is applying security arch tubes to 140 of its new locomotives.

17) Railway Administrations in general seek the advantages to be gained by well proportioned steam circuits.

18) No Administration reports experience with preheating air.

19) On the whole, compounding is adversely criticised on the score of greater complication with resultant higher maintenance costs.

20) None of the Administrations favours stream lining primarily because the maximum speeds worked do not warrant it and also because of the resultant inaccessibility of parts requiring constant attention.

Railway System	Class	Type	Number	Date in service
<i>South African Railways.</i>	S 1	Heavy shunting	37	1947-1950, 1953
	S 2	Light shunting	100	1952-1953
	15 E	Main line	19	1937
	19 C	Branch line	40	1937
	19 D	Branch line	195	1938-1939, 1945-1951
	23	Main line	136	1938-1939
	15F	Main line	255	1938-1939, 1944-1951
	GM	Branch line, Garratt	41	1938-1939, 1953
	GEA	Branch line, Garratt	50	1946-1947
	24	Light branch line	100	1949-1950
	25	Main line	140	1953
	GMA	Branch line Garratt	25	1953
	GO	Branch line Garratt	25	1953
		Total	1 163	
<i>Indian Railways</i>	WW	Passenger shunter	4	1937
	WU	Light shuttle	4	1937
	WM	Medium shuttle	40	1937, 1950
	WP	Standard Passenger	316	1947-1949
	WG	Standard Goods	149	1950-1952
	YP	Standard Passenger (Metre Gauge)	78	1950-1952
	YG	Standard Goods (Metre Gauge)	150	1950-1951
		Total	741	
<i>Ceylon Railway</i>	C.1A	Mixed traffic	8	1946
	B.1 - B1.E	Mixed traffic	49	1948
	A.3 - A.3D	Mixed traffic	15	1951
		Total	72	
<i>Danish State Railways</i>	H	Goods	17	1941
	F	Passenger and Goods	36	1948
		Total	53	
<i>Indonesian Railways</i>	D 52	Freight traffic	100	1951
		Total	100	
<i>Victorian Railways</i>	X		18	1937-38, 1942-43,
	K		43	1940-41, 1943,
	H		1	1941
	N	Goods	50	1949-51
	R	Passenger	70	1951-1952
		Total	182	
		Grand Total	2 311	

NOTE : Indian Railways :  
Victorian Railways :  
South African Railways :

Tractive Effort calculated on 85 % of Boiler Pressure.  
» » » » ditto » » »  
» » » » 75 % » » »

Tractive Effort		Wheel arrangement	Boiler Pressure		Remarks
Lbs.	Met. tonn.		lbs./sq. in.	kg/sq. cm.	
8 000	17.24	0-8-0	180	12.65	In course of delivery Balance of order of 44 Balance of order of 50
5 600	11.6	0-8-0	195	13.7	
2 340	19.2	4-8-2	210	14.8	
1 850	14.45	4-8-2	200	14.1	
1 850	14.45	4-8-2	200	14.1	
3 200	19.6	4-8-2	225	15.8	
2 340	19.2	4-8-2	210	14.8	
0 700	27.5		200	14.1	
5 620	25.2	4-8-2-2-8-4	200	14.1	
7 600	12.5		200	14.1	
2 340	19.2		225	15.8	In course of delivery Delivery commencing Delivery late 1953
0 700	27.5	4-8-2-2-8-4	200	14.1	
9 400	22.4	4-8-2-2-8-4	200	14.1	
9 710	8.94	0-6-2	210	14.75	
2 750	5.8	2-4-2	210	14.75	
9 043	8.6	2-6-4	210	14.75	
0 600	13.9	4-6-2	210	14.75	
8 890	17.6	2-8-2	210	14.75	
8 400	8.35	4-6-2	210	14.75	
3 450	10.64	2-8-2	210	14.75	
8 000	8.16	2-6-2 : 2-6-2	185	13.0	
1 663	9.83	4-6-0	160	11.25	
8 436	17.43	4-8-0	180	12.65	
—	—	2-8-0	171	12	
—	—	4-6-2	185	13	
5 200	15.9	2-8-2	228	16	
9 360	17.9	2-8-2	205	14.4	TE. 48 360 lb. (21.9) with booster.
8 650	12.99	2-8-0	175	12.3	
5 000	24.95	4-8-4	220	15.5	
8 650	12.99	2-8-2	175	12.3	
2 080	14.55	4-6-4	210	14.75	

Indonesian Railways : Tractive Effort calculated on 70 % of Boiler Pressure.  
Ceylon Government Railway : » » » » mean effective pressure.



## APPENDIX A/4.

## Details of boilers for rationalised locomotives : Indian Railways.

GAUGE		5'6" (1.68 metres)				3'3 3/8" (1 metre)
TYPE OF LOCO		WP-4-6-2 WG-2-8-2	0-6-2	2-4-2	2-6-4	YP-4-6-2 YG-2-8-2
CLASS OF LOCO		WP WG	WW	WU	WM	YP & YG
Grate Area	Sq. ft.	46	14	18.5	24.6	28.0
	Sq. m	4.28	1.3	1.72	2.29	2.601
Firebox volume	Cu. ft.	300	62	77	104	156
	Cu. m	8.4	1.735	2.16	2.91	4.37
Distance between tube plates (m) . .		4.82	2.937	2.937	3.46	3.93
Flues No. & Dia. . . . . (dia. in cm) . . . . .		38 13.97	18 13.33	18 13.33	21 13.33	26 13.33
Tubes No. & Dia. . . . . (dia. in cm) . . . . .		118 5.72	79 4.45	96 4.45	85 5.08	67 5.08
Superheater elements outside dia. cm		3.81	3.81	3.81	3.49	3.49
Free gas area through flues & tubes sq. cm . . . . .		5 850	2 315	2 510	3 120	3 280
Surface area of tubes & flues (gas contact) sq. m . . . . .		246	70.0	75.7	97.2	114.5
Heating surface flues sq. m . . . .		80.0	22.1	22.1	30.5	42.6
Heating surface tubes sq. m . . . .		102.0	32.4	39.3	47.0	42.5
Firebox heating surface sq. m . . .		25.6	7.5	7.5	12.2	18.2

## Details of boilers for rationalised locomotives : Indian Railways. (Continued.)

Superheater heating surface sq. m . . .	63.5	16.9	16.9	21.4	30.8
Total heating surface sq. m . . . . .	271.1	78.9	85.8	111.1	134.1
Firebox volume					
Vol. in. cu. ft.					
Grate area	6.52	4.43	4.16	4.23	5.57
»    Area in. sq. ft.					
»    Vol. in. cu. m	1.96	1.335	1.255	1.27	1.68
»    Area in. sq. m					
Free gas in sq. m	13.8%	17.8%	14.6%	13.6%	12.6%
Grate area in sq. m					
Gas contact surface flue & tubes.	420	302	301	310	349
Gas flow area flues and tubes.					
Total cross sectional area through S.H. Elements. sq. cm . . . . .	282.0	134	134	126	171
Distance between Firebox tubeplate and end of superheater elements. cm .	45.72	50.5	50.5	48.0	91.5

The following boiler ratios have been adopted by Indian Railways to obtain the best results with low grade non-coking coals. In working out detail design these ratios are adhered to wherever possible :

$$\frac{\text{Firebox volume in cu. ft.}}{\text{Grate area in sq. ft.}} = 6.5 \text{ minimum}$$

$$\frac{\text{Free gas area in tubes & flues, in sq. m}}{\text{Grate area in sq. m}} = 12 \% \text{ minimum}$$

$$\frac{\text{Surface area of flues & tubes in sq. m}}{\text{Free gas area in tubes & flues in sq. m}} = 420 \text{ max. for superheat temp. of } 700^{\circ}\text{F.} - 380 \text{ max. for superheat temp. of } 720^{\circ}\text{F.}$$

## APPENDIX A/5.

## South African Railway

1.	Class of Locomotive	25	23, 15 F
2.	Standard boiler No. . . . .	—	3B
3.	Number of boilers . . . . .	140	435
4.	Date in service . . . . .	1953	1935-1948
5.	Grate area - sq. ft. . . . .	70.2	62.5
6.	Combustion chamber length - ins. . . . .	42	—
7.	Wagner ratio - Flue tubes . . . . .	408	473
8.	Wagner ratio - Boiler tubes . . . . .	405	483
9.	No. and outside diameter of boiler tubes . . . . .	158/2.5	136/2.5
10.	No. and outside diameter of flue tubes . . . . .	40/5.5	36/5.5
11.	Effective gas area thro' tubes - sq. ft. . . . .	8.75	7.77
12.	Heating surface - Tubes - sq. ft. . . . .	3 041	3 169
13.	Heating surface - Firebox - sq. ft. . . . .	317	232
14.	Heating surface - Total - sq. ft. . . . .	3 358	3 401
15.	Superheating surface - Steam side - sq. ft. . . . .	663	676
16.	Effective gas area, } Grate area . . . . .	12.50	12.43
17.	Firebox heating surface per sq. ft. grate . . . . .	4.53	3.71
18.	Tubes heating surface per sq. ft. grate . . . . .	43.40	50.70
19.	Total heating surface per sq. ft. grate . . . . .	47.93	54.41
20.	Distance over tube plates - ft. . . . .	19' 0"	22' 7 1/2"
21.	Firebox tube plate bridge distance - ins. . . . .	3/4"	1-1/8"
22.	Gas area through flue tubes, } Total gas area. . . . .	50.1	51.5
23.	Ratio { Tubes heating surface . . . . . { Firebox heating surface . . . . .	9.66	13.7
24.	Firebox volume - cub. ft. . . . .	432	311
25.	Ratio { Firebox volume . . . . . { Grate area . . . . .	6.17	4.98
26.	Method of firing . . . . .	Mech.	Mech.



r proportions

19D	24	GEA Garratt	GMA Garratt	GO Garratt
1A	1	—	—	—
300	100	50	25	25
1935-1948	1949	1946	On order	On order
36.3	36.3	51.3	63.0	56.6
—	—	—	—	—
426	373	314	373	373
432	378	321	370	370
76/2.5	76/2.5	282/2"	285/2"	241/2"
24/5.5	24/5.5	36/5 1/2"	50/5 1/2"	36/5 1/2"
4.78	4.78	8.28	9.79	7.68
1 700	1 496	2 328	2 992	2 410
139	139	212	242	233
1 839	1 635	2 540	3 234	2 643
404	380	470	778	560
13.23	13.23	16.14	15.30	13.56
3.86	3.86	4.13	3.78	4.12
47.20	41.60	45.40	46.80	42.63
51.06	45.46	49.53	50.58	46.75
20' 3 1/2"	17' 9"	11' 10 1/8"	13' 8"	13' 8"
7/8"	7/8"	31/32"	3/4"	3/4"
55.8	55.8	43.2	50.3	46.3
12.23	10.77	10.97	12.36	10.35
145	145	—	283	300
4.03	4.03	—	4.42	5.31
Hand.	Hand.	Hand.	Mech.	Mech.

## APPENDIX A/6

Weight of boiler in service per kg/h of steam produced.

Railway	Class of locomotive	Weight of boiler (kg)	Boiler pressure (kg/sq. cm)	Maximum steaming capacity (kg/h)	Weight of boiler in kg/h of steam
South African Railways	24	24 500	14.1 (200 lbs. sq. in.)	13 600	1.80
	19D	27 600	14.1 (200 lb. sq. in.)	13 600	2.03
	15F	33 500	14.8 (210 lb. sq. in.)	21 600	1.57
	23	33 900	15.8 (225 lb. sq. in.)	21 600	1.55
	25	37 200	15.8 (225 lb. sq. in.)	25 000	1.49
	GM	32 000	14.1 (200 lb. sq. in.)	21 000	1.52
Indian Railways	WP & WG	25 500	14.8 (210 lb. sq. in.)	—	3.08
	WM	15 350	14.8 (210 lb. sq. in.)	—	2.90
	YP & YG	2 300	14.8 (210 lb. sq. in.)	—	4.0

## APPENDIX A/7.

Brief specifications of I.R.S. materials referred to in answers to I.R.C.A. questionnaire  
Indian Railways

I.R.S. Specn	Class & Particulars	Chemical Composition				Process of Manufacture	Tensile strength tons sq. in.	% Elong- ation Min.	Remarks
		C	Mn	S	P				
M. 6	V	0.23 0.30	—	0.05 Max.	0.05 Max.	O.H. bas., O.H. acid Duplex.	26-32 (41-50.4 kg/sq. mm)	27	plates, sections, bars etc. Boiler quality
R. 21	V to IRS. M. 6	0.23 0.30	—	0.05 Max.	0.05 Max.	O.H. bas., O.H. acid Duplex.	26-32 (41-50.4 kg/sq. mm)	27	Steel plates for loco boiler
R. 29	Plates for inside firebox	0.12 0.15	0.30 0.50	0.05 Max.	0.04 Max.	O.H. acid & electric	23-28 (36.2- 44.1 kg/sq. mm)	25	Steel plates for loco inside box
M. 26	XI	0.38 0.45	—	0.04 Max.	0.04 Max.	—do—	40-45 (63-70.9 kg/sq. mm)	20-15	Blooms, forgings & bars
M. 2	Steel Casting	—	—	0.06 Max.	0.06 Max.	O.H. electric & acid Bessemer	26 (41 kg/sq. mm)	20	
M. 31	Grade 12-49	—	—	—	—	Casting cast from metal melted in suitable melting plants. Blast furn- ace metal unsuit- able.	11-13 (17.3- 20.45 kg/sq. mm)	—	Grey iron casting
R. 4	Copper.	As 0.3 0.5	Sb 0.05 Max.	Bi 0.01 Max.	O 0.1 Max.		14 Min (22 kg/sq. mm)	35	Copper not less than 99.2 %



## ANNEXURE A/8.

## Brief specifications of boiler materials.

Railway	Purpose	Chemical composition					Tensile strength (ton per sq. inch.)	Yield (tons per sq. inch)	Elongation	Process of manufacture
		C.	Mn.	P.	S.	incidental Cu.				
South African Railways	Inner firebox	.025	.30 <sub>1.0</sub>	.04	.04	.025	24.5-29 (38.6-45.6 kg per mm <sup>2</sup> )	13.8	25 % min. in 8 in. 29 % min. in 2 in.	acid or basic open hearth.
	Barrel and outer firebox			.05	.05		26-32 41-50.5 kg per mm <sup>2</sup> )		22-24 % minimum	acid baric open hearth
	Boiler and flue tubes Superheater elements			.05	.05		20-28 (31.5-44 kg per mm <sup>2</sup> )		18-20 % in 8 in. 28-30 % in 2 in.	open hearth or electric
Danish State Railways	Boiler plate			.05	.05		21.6-26.7 (34-42 kg per mm <sup>2</sup> )		25 % min. in 8 in. (tensile + elonga- tion not less than 62)	Selected basic. Siemens- Martin steel.
	Boiler tubes						21.6-25.4 (34-40 kg per mm <sup>2</sup> )		25 % min. on length equal to $11.3\sqrt{F}$ F = section of test price	
Victorian Railways	Barrel plates						26-30 (41-47.2 kg per mm <sup>2</sup> )		23 % minimum	
	Inner firebox						24-28 (37.8-44 kg per mm <sup>2</sup> )		25 % minimum	

	Carbon %	Manga- nese %	Copper %	Silicon %	Nickel %	Sul- phur %	Phos- pho- rous %	Tensile strength (tons per sq. inch)	Elon- gation %	Boiler pressure (lb. per sq. inch)
(i)	.12-.16	.7	.6-.9	.2-.4	.2-.5	—	—	30-35 (47.2-55 kg per sq. mm)	18-20	210 and 225 (14.8-15.8 kg per sq. cm)
(ii)	.2-.25	.5-.7	—	.1-.15	1.75-2	.04	.04	34-38 (53.5-59.8 kg per sq. mm)	22-24	210 (14.8 kg per sq. cm)
(iii)	.2 max.	.5-.8	—	.2 max.	2 min.	.04	.04	34-38 (53.5-59.8 kg/sq. mm)	22-24	225 (15.8 kg per sq. cm)

## APPENDIX A/11.

## Characteristics of coals used

Railway system	Calorific value		Moisture %	Volatile Matter %	Fixed Carbon %	Sulphur %	Ash %	Ash fusion temperature C°
	B.T.U./lb.	K.cal/kg.						
Victorian Railways	12 000	6 670	3.24	26.82	57.19	—	12.75	
Indian Railways Passenger coal Goods coal	12 660	7 020	0.8	24.63	55.95	0.3	19.12	
	11 394	6 330	3.25	26.09	53.01	0.7	20.20	
Danish State Railways (average)	12 250	6 800	7	32	—	—	5	
South African Railways Typical Transvaal Coal Typical Natal Coal	12 300	6 840	1.7	26.8	59.1	0.8	13.0	1 395
	12 600	7 000	1.0	18.1	64.8	—	16.1	1 400

## APPENDIX A/10.

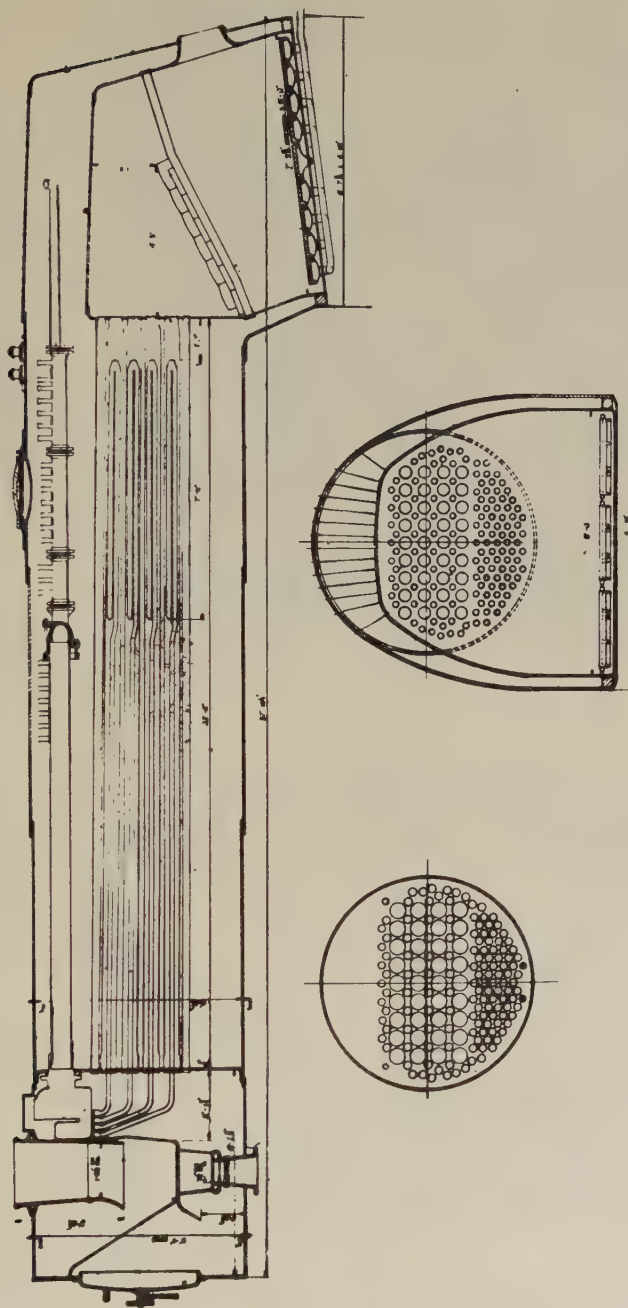
Thickness of boiler plates for rationalised locomotives  
Indian Railways.

THICKNESS OF PLATES GIVEN IN CM.					
Gauge . . . . .	5'-6"				3'-3 3/8"
Locomotive . . . .	WP & WG	WW	WU	WM	YP & YG
Barrel plate :					
1st Course . . . .	1.905	1.43	1.35	1.51	1.59
2nd Course . . . .	1.905	—	—	1.51	1.59
3rd Course . . . .	2.064	—	—	—	—
Tube plate :					
Smoke box . . . .	2.22	2.22	2.22	2.22	1.905
Fire box . . . . .	1.27	1.27	2.54	1.27	1.27
Firebox :					
Inside . . . . .	0.95	0.95	1.27	0.95	0.95
Wrapper plate :					
Outside. . . . .	1.59	1.43	1.27	1.43	1.59
Throat plate :					
Inside . . . . .	1.27	—	—	—	1.27
Outside. . . . .	2.22	1.59	1.43	1.59	1.75
Back plate :					
Inside . . . . .	0.95	0.95	1.27	0.95	0.95
Outside. . . . .	1.27	1.43	1.27	1.43	1.27
Material	<div> <div>Inside Firebox Complete</div> <div>Steel IRS R-29</div> <div>Copper IRS R-4</div> <div>Steel I.R.S. R-29</div> </div>				
	Other plates : Steel I.R.S. class V M6 and R21.				
Boiler wt. per kg/hr of steam production	3.08	—	—	2.90	4.0



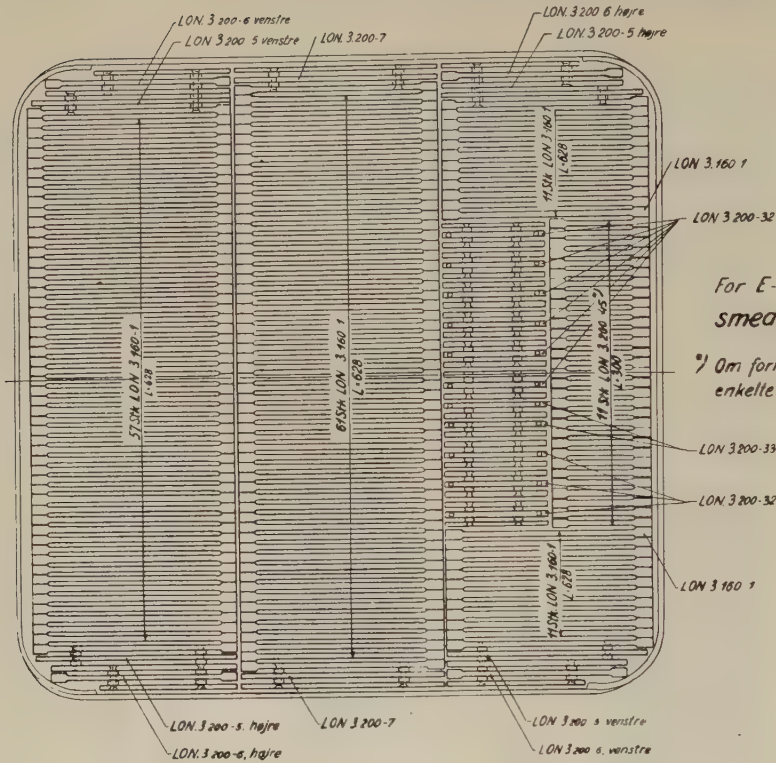
## ANNEXURE A/12.

## SOUTH AFRICAN RAILWAYS.



Sketch of std. No. 38 locomotive boiler class 23 &amp; 5f.

FIRE GRATE. DANISH STATE RAILWAYS.



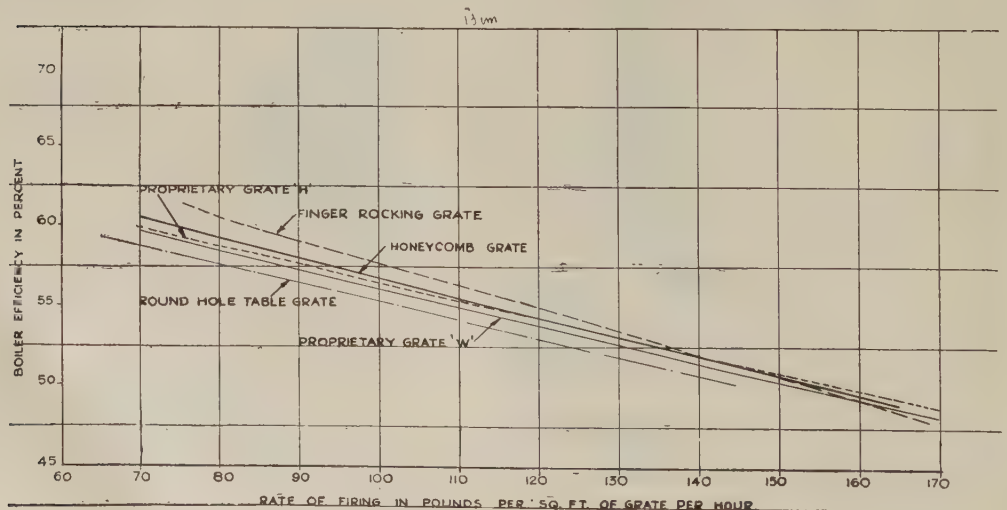
For E-maskiner med  
smedejerns-riste.

\*) Om fornødent kan anvendes enkelte bundter efter LON 3.200-46

ANNEXURE B/2.

## INDIAN RAILWAYS.

Comparative boiler efficiency curves with different types of grates.  
(Trials made with «AWE», «NM» — GARRATT and «H» locomotives.)







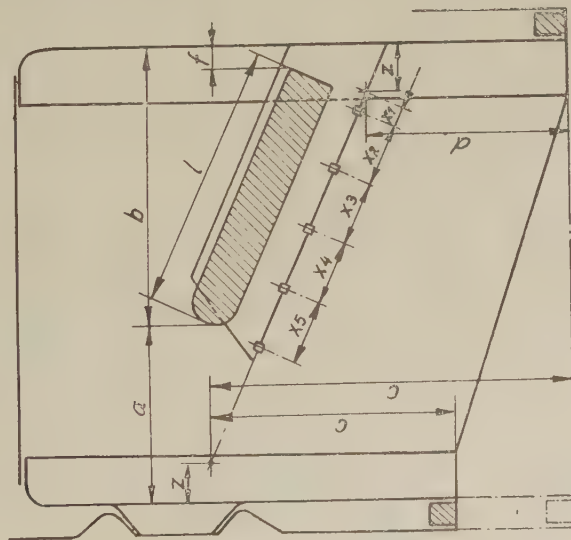
## ANNEXURE B/4.

## Particulars of grates used in recent standard locomotives

## Indian Railways.

Gauge . . . . .	5'-6" 1.676 m				3'-3 3/8" 1.0 m
Locomotive . . . .	WP & WG	WW	WU	WM	YP & YG
Grate area : sq. ft.	46.0	14.0	18.5	24.6	28.0
	4.27 sq. m.	1.3 sq. m.	1.72 sq. m.	2.29 sq. m.	2.6 sq. m.
Air passage area through grate : sq. ft.	18.8	5.55	7.97	12.4	14.6
	1.75 sq. m.	.515 sq. m.	.74 sq. m.	1.155 sq. m.	1.36 sq. m.
Main area into ashpan : sq. ft. . . . .	7.25	2.96	3.08	4.9	4.2
	.675 sq. m.	.275 sq. m.	.286 sq. m.	.455 sq. m.	.39 sq. m.
Air passage area ————— × 100	40.8 %	39.8 %	43 %	50.5 %	52 %
Grate area					
Air area into ashpan ————— × 100	15.75 %	21.2 %	16.65 %	19.8 %	15.0 %
Grate area					
Type of grate . . .	STD Finger rocking grate without drop grate	Finger rocking grate with drop grate			STD Finger rocking grate without drop grate

DANISH STATE RAILWAYS.  
BRICK ARCHES FOR DIFFERENT TYPES  
OF LOCOMOTIVES.



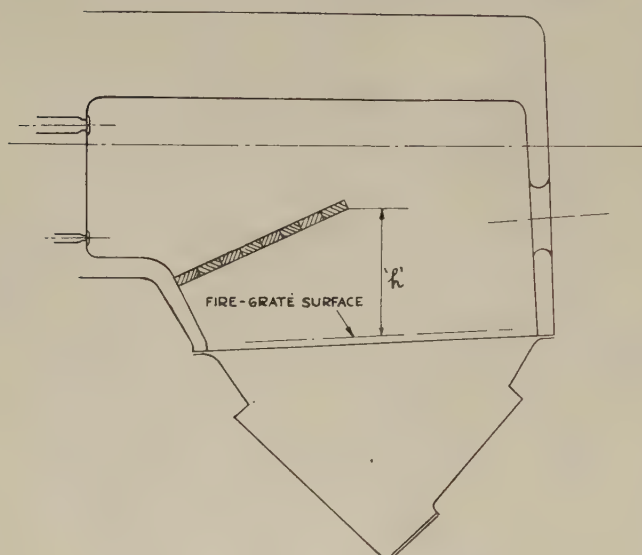
De lodrette mål galder også for fyrcasser med skråtstil-  
lede dør-og rørplader og skråtliggende bundramme.  
Mål Z måles altid vinkelret på dør-og rørplade.  
For loko. litra E1-II og P1-II er midtersten anbragt på  
tværs af fyrcasse. Radius til alle murbuer = 1 800 mm.

Litra	Antal knaster	f	l	a	b	a+b	$\frac{a+b}{1000}$	d	c	z	x1	x2	x3	x4	x5
A	3	50	730	700	750	1450	48	400	860	100	130	225	225		
C, K II	4	100	850	795	935	1730	46	750	1190	100	120	225	300	210	
D II	4	100	850	795	935	1730	46	530	700	100	110	250	250	200	
D III	4	100	850	935	935	1870	50	530	700	100	140	260	260	200	
D IV	4	100	850	1045	935	1980	53	760	935	100	130	225	305	200	
D F															
E I, E II	5	100	905	900	1000	1900	47	450	900	100	20	170	255	190	90
F II	2	50	470	635	515	1150	55	585	980	100	110	300			
F III	2	50	470	637	512	1149	55	510	830	100	100	240			
G II, G III	3	50	730	700	750	1450	48	490	1010	100	320	235			
H I-II, R I-II	4	100	850	1750	950	2700	65	765	900	100	75	200	270	285	
HS I, HS II	2	50	470	375	480	855	44	230	650	100	140	245			
J II	2	50	470	637	512	1149	55	510	830	100	140	220			
K I	4	100	850	795	935	1730	46	540	1090	100	110	210	325	200	
O	3	50	730	700	750	1450	48	610	1080	100	120	300	270		
P I, P II	4	100	700	800	680	1480	54	510	1010	100	50	170	285	100	
PR I, PR II	4	100	850	1835	865	2700	68	790	1700	150	30	195	220	345	
Q I	4	100	850	775	955	1730	45	530	700	100	110	245	250	220	
Q II	4	100	850	791	955	1746	45	530	700	100	115	250	250	250	
S	5	100	850	1450	950	2400	60	700	1010	100	125	190	185	185	185
T	4	100	850	1550	950	2500	62	675	1080	100	75	250	250	250	

## ANNEXURE B/6.

## INDIAN RAILWAYS.

Sketch showing height of brick-arch above fire grate for various classes of loco. boilers.

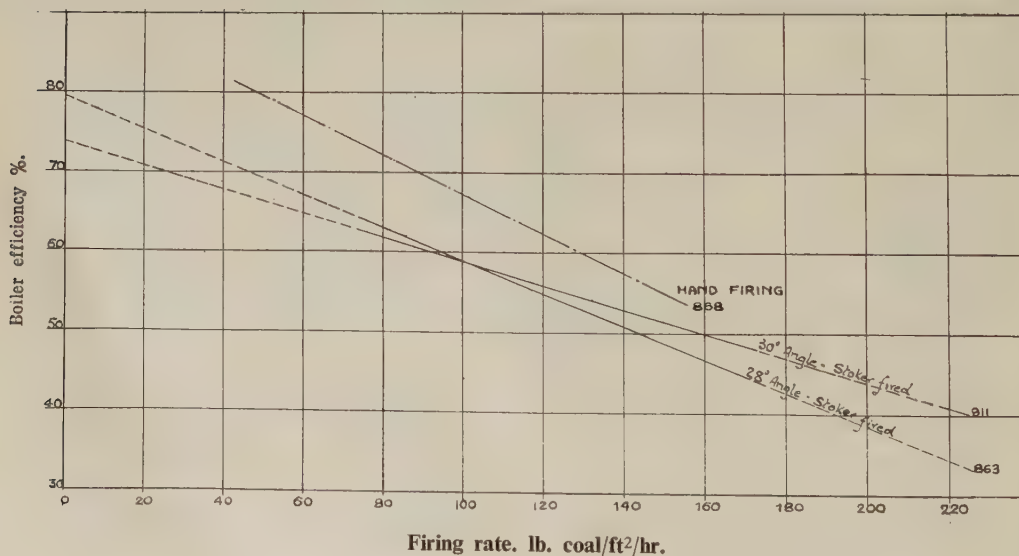


Gauge	Class of Boiler	Height $h$ in inches
Broad	X A	29
	X B	35 1/2
	X C	35
	X D	31
	X E	37 1/2
	WP/WG	45
Metre	Y B	33
	Y C	32
	Y D	29
	YP/YG	35

## APPENDIX B/7.

## SOUTH AFRICAN RAILWAYS.

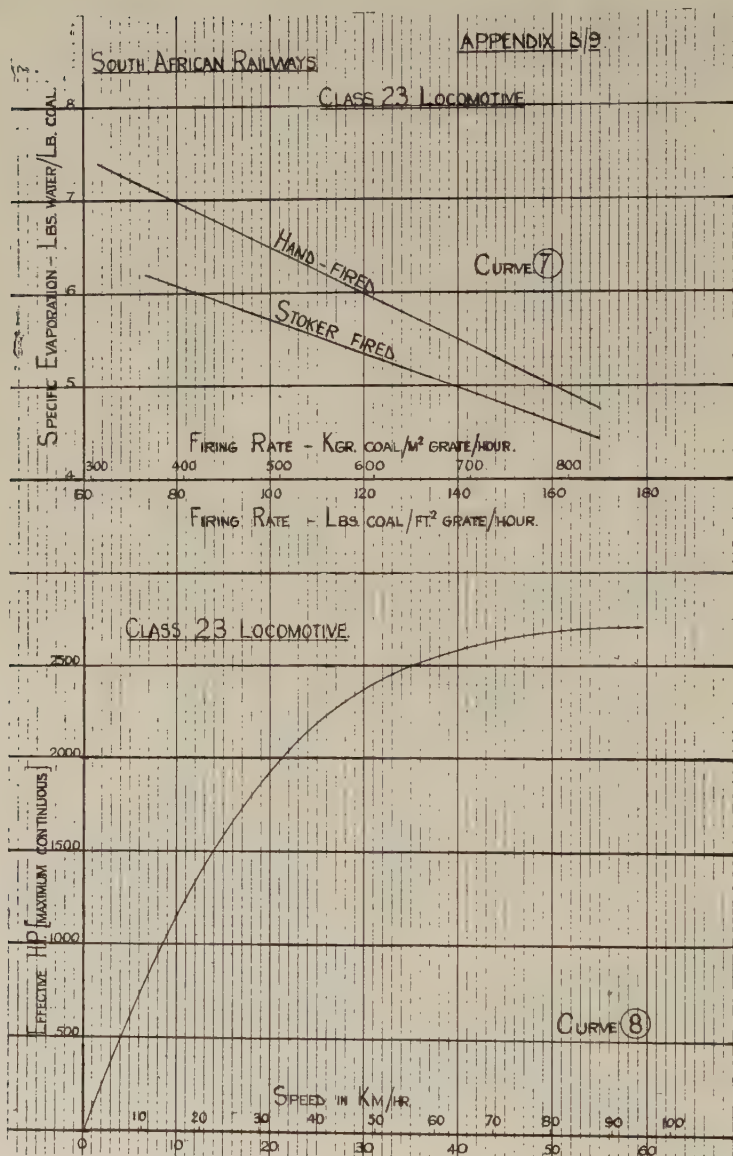
Angle between brick arch & grate — Standard 3B boiler.





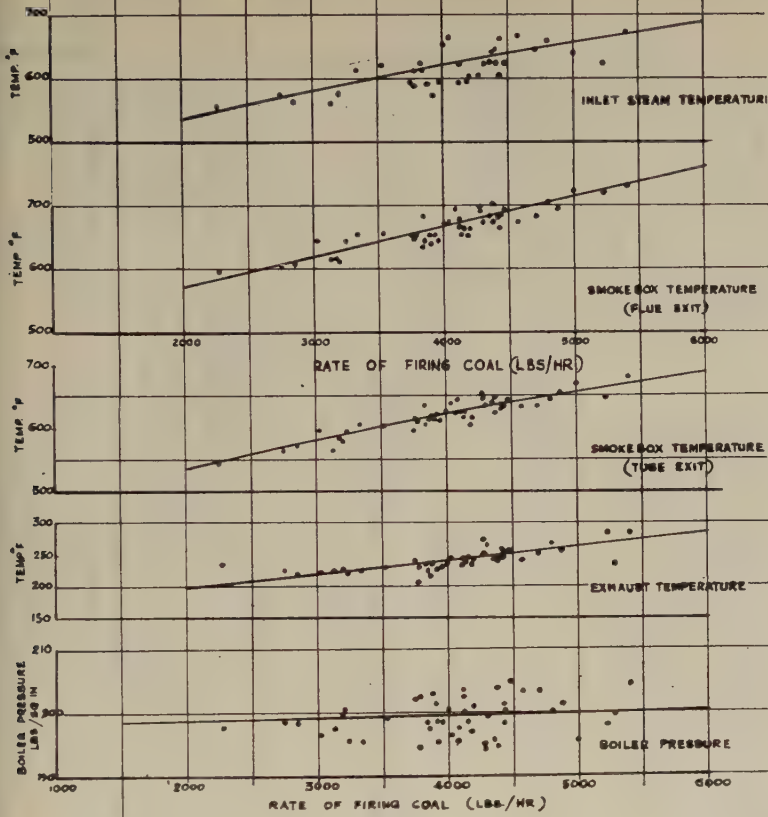
## South African Railways : Locomotives with mechanical stokers.

Class	No. of locomotives	Type of stoker	Maximum firing rate	Grate areas	Remarks
GM	16	Standard stoker HTI	10 500 lb/hr. (4 760 kg/hr)	64 sq. ft. (6.0 sq. m)	In service
15 F	101	» » HTI	ditto	63 sq. ft. (5.88 sq. m)	In service
23	136	» » HTI	ditto	63 sq. ft. (5.88 sq. m)	In service
GL	8	» » D4-A	12 000 lb/hr. (5 420 kg/hr)	75 sq. ft. (7.0 sq. m)	In service
25	110	» » HT	12 000 lb/hr. (5 420 kg/hr)	69 sq. ft. (6.45 sq. m)	On order
25	30	Berkley	12 000 lb/hr. (5 420 kg/hr)	69 sq. ft. (6.45 sq. m)	On order
GMA	25	Standard stoker HTI	10 500 lb/hr. (4 760 kg/hr)	64 sq. ft. (6.0 sq. m)	On order
GO	25	» » HTI	ditto	56 sq. ft. (5.22 sq. m)	On order
15 F	131	» » HTI	ditto	63 sq. ft. (5.88 sq. m)	Being fitted
Total	582				



Speed in m.p.h.

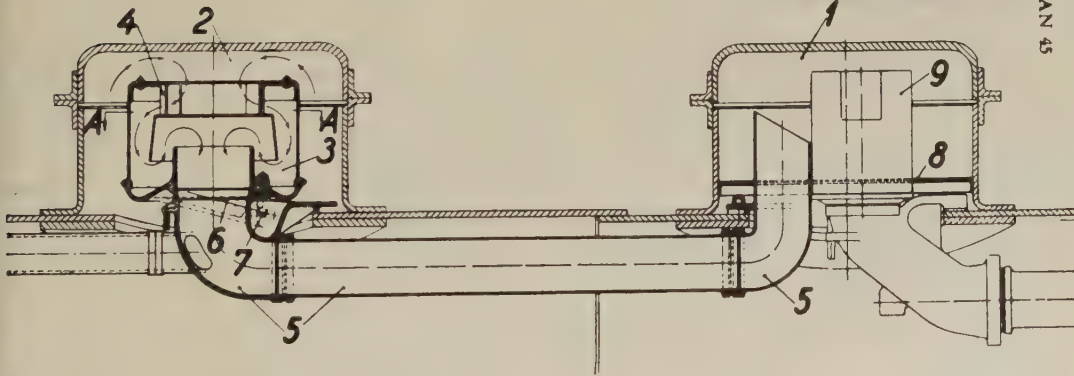
TEMPERATURE & PRESSURE VARIATION CURVES FOR 'W6' LOCOMOTIVE  
(SPECIFIED BOILER PRESSURE 20 LBS/SQ. IN. SUPERHEAT TEMP 600-750° F.)  
COAL DATA WITH AVAILABLE CALORIFIC VALUE 10544 B.T.U./LB.



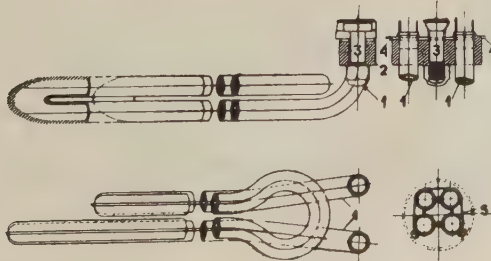
ANNEXURE C/2

DANISH STATE RAILWAYS  
ARRANGEMENT OF STEAM DRIER

PLAN 45



Snit A-A





## APPENDIX C/3.

## Characteristics of cylinder lubricating oils.

Type	South African Railways		Indian Railways		Victorian Railways		Danish Railways	
	Compounded		Pure Mineral	Compounded	Pure Mineral	Compounded	Pure Mineral	Compounded
Specific gravity . . .	.924-.910 at 60 °F (15.5 °C)		Not above .900 at 30 °C/30 °C	Not above .900 at 30 °C/30 °C	—	Not above .900 at 30 °C/30 °C	.92 at 20 °C (78 °F)	
Flash point . . . . .	Flash point PM 540 °F		Flash point PM - not below 280 °C (536 °F)	Flash point PM - not below 280 °C (536 °F)	Fire point 580 °F	Flash point PM - not below 280 °C (536 °F)	Fire point - Min. 315 °C (Open apparatus) (599 °F)	
Viscosity . . . . .	Flash point COC 590 °F							
	Fire point COC 670 °F							
	Saybolt at 130 °F 1 708		Redwood at 100 °C (212 °F) Not below 160	Redwood at 100 °C (212 °F) - Not below 150	Dynes per sq. cm at 210 °F = .40 max. - .23 min.		50°-80° Engler at 20 °C	
	Saybolt at 210 °F 220							
	Redwood at 140 °F 1 072							
Equivalent kinematic viscosity - centistokes . . . . .	Redwood at 200 °F 239							
	47.2 at 210 °F 75 °F (24 °C) max.		± 40 at 210 °F	± 40 at 210 °F	43.48-25 at 210 °F 50 °F (10 °C)		(380-608 at 122 °F) Must be liquid at normal temperatures	
Compounding. . . . .	4 % acidless tallow		—	5 % approved fatty oil	—		—	
Carbon residue . . . . .	4 % max.		—	—	3 % max.		—	
Ash . . . . .	—		Not more than .05 %	Not more than .05 %	—		—	
Saponifiable matter .	—				6 % max.		—	
Organic acids (SO <sub>3</sub> ) .	—				—		.05 %	
Colour . . . . .	Green							
Remarks . . . . .	—		Specification No. G/O 101/33 For superheated locomotives	Specification No. G/O 101/34, Not suitable for conditions which cause difficulties from emulsification of the oil For locomotives using steam at temperatures exceeding about 500 °F (260 °C)	The oil must be a well refined product, free from mineral acids, alkalies, and foreign matters		The oil must be thoroughly filtered mineral oil without additives, free from water, solid matter, inorganic acids, and alkalies	

ANNEXURE No. E.1.

## South African Railways

*Laboratory.*

Beaufort West.

Date,

15th May, 1953.

Lime-soda softener. Krom Rivier.

*Mixing Mill — Full*

## Mixing Mill — Full

Width adj. weir —  $1\frac{1}{2}$ "

Spray pipes — brok

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Time 1.15 p.m.  
Depth main weir 2 1/4"  
Return pipe — clean  
Flow level from top 18'  
Filter beds — dirty.

*Condition of plant* — New bearings required for spider wheel and driving shaft in reagent tank.

**Summary of water analysis for the period 30.4.1953 to 14.5.1953.**

Day	Treated					Column					Raw				Reagents — lbs.		
															Per charge		
	H	P	M	O	S	N	H	Tan	H	M	Lime	Soda	Na	Briq. Tannin		No. 18	
														Al	Floc		
														per	per		
														day	day		
30.4.53	000	144	236	052	236	184	010	015	420	324	675	220	80	10	150		
1.5.53	005	188	188	028	183	155	010	020	412	308	»	»	»	»	»	»	»
2.5.53	030	074	146	002	116	114	105	018	400	324	»	»	»	»	»	»	»
3.5.53	013	092	166	018	153	135	020	025	380	312	»	»	»	»	»	»	»
4.5.53	033	086	166	006*	133	127	030	015	400	320	»	»	»	»	»	»	»
5.5.53	120	082	232	068	112	—	090	033	500	360	»	»	»	»	»	»	»
6.5.53	045	074	170	022	125	—	100	030	492	364	»	»	»	»	»	»	»
7.5.53	050	086	198	026	148	—	—	—	—	—	»	»	»	»	»	»	»
8.5.53	003	146	220	072	217	145	030	033	428	340	700	220	80	10	150		
9.5.53	010	124	200	048	190	142	023	018	400	320	»	»	»	»	»	»	»
10.5.53	040	076	150	002	110	102	030	035	480	352	»	»	»	»	»	»	»
13.5.53	015	088	160	016	145	129	—	—	—	—	»	»	»	»	»	»	»
14.5.53	010	106	170	042	160	118	125	005	400	320	»	»	»	»	»	»	»

Remarks : Plant stopped 11th and 12th Waterwheel repaired, driving chain shortened.

Under treatment 5-7th May, due to change in raw water.

Adjustable weir increased to  $1\frac{1}{2}$ " from  $11/16$ " on 13th May, 1953.

## ANNEXURE E/2.

## South African Railways.

Laboratory,  
PORT ELIZABETH.  
Date — 1st April, 1953.  
Reference — CM.5.

Submitted fortnightly.

Base exchange plant — Alicedale. Date — 18th March, 1953. Time 5.30 p.m.

*Inlet pressure; Outlet pressure.*

Softener . . . . . 41 . . . . . 37 Regeneration. Setting . . . . . 70 000 gall.  
Pressure filters . . . . . 43 . . . . . 44 Pumping rate . . . . . 6'400 gall.

Multiport valve O.K. Salt saturators : Left — out of order.  
Right — full.

Brine tank — 3/4 S.G.Of brine — 1.2 Brine taken 122 gall (waste water).

Wash time — 16 min. Rinse time — 24 min. (compartment — clean).

Chart recorder — working. Condition of plant — fair.

Bypass feeder — working. Tannin per day — 268 lbs/day;  
Fused soda ash — 32 lbs/day.

Clarification : Flocculation — O.K. Clarity — water clear.

## Summary of water analysis for the period 16th March, 1953 to 31st March, 1953.

## TREATED EX COL.

## RAW

Date	H	M	Cl	TAN	pH	H	M	Cl
16.3.1953	000	136	120	040	6.9	—	—	—
18.3.1953	000	140	100	045	6.9	162	110	084
20.3.1953	000	140	096	035	7.0	186	116	080
23.3.1953	020	128	180	050	6.9	—	—	—
25.3.1953	015	132	120	055	6.9	164	116	086
27.3.1953	010	146	150	050	6.9	—	—	—
30.3.1953	020	152	110	060	6.9	166	126	090
Raw water analysis. Date 16th Marsh, 1953.					H	P	M	Cl
					158	000	150	084
							TDS	pH
							333	7.2

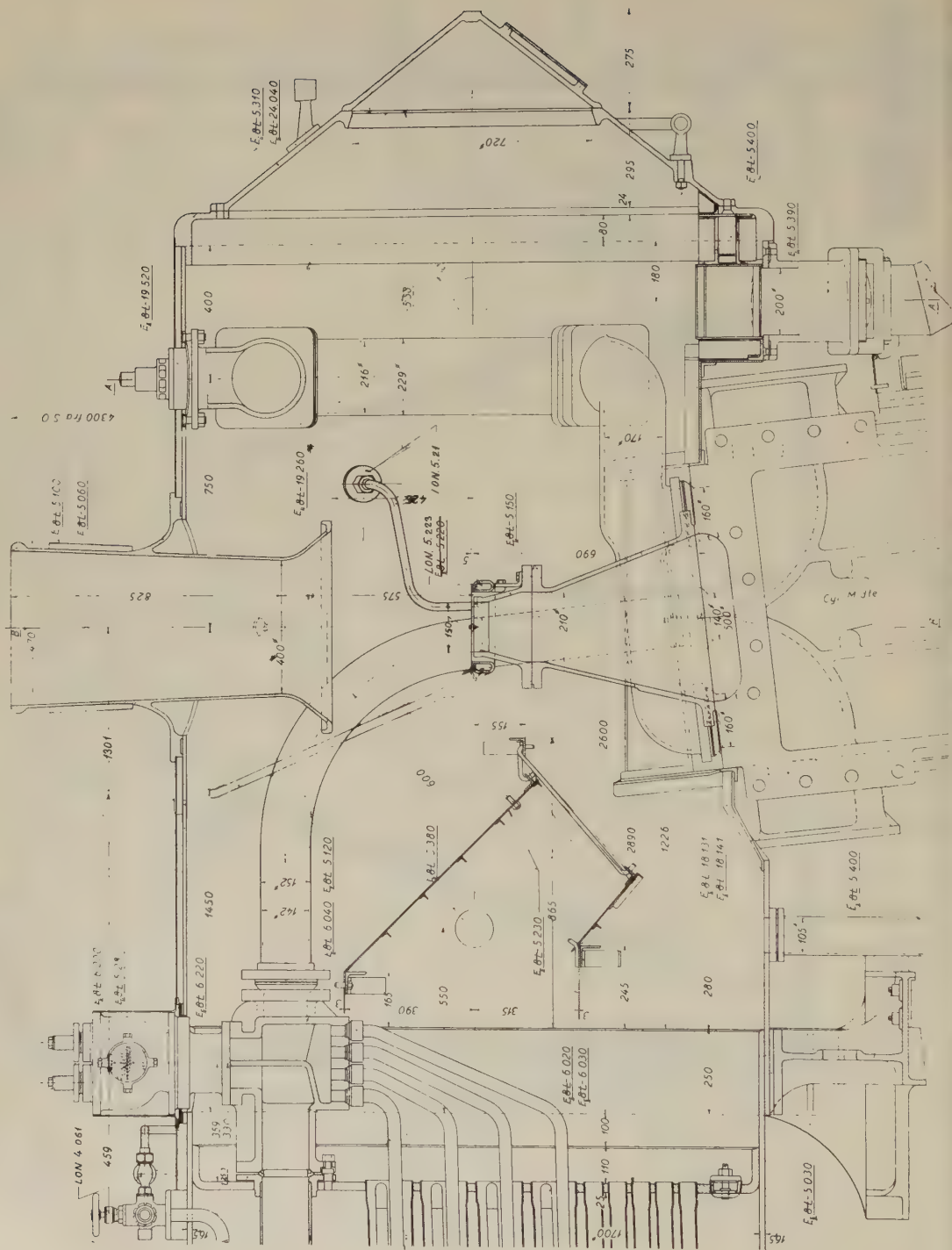
Remarks : Plant operating satisfactorily up to 21st March, 1953, when left saturator started leaking.  
Brine tank does not fill up properly resulting in Zeolite being brine starved.

sgd,

Water treatment officer.

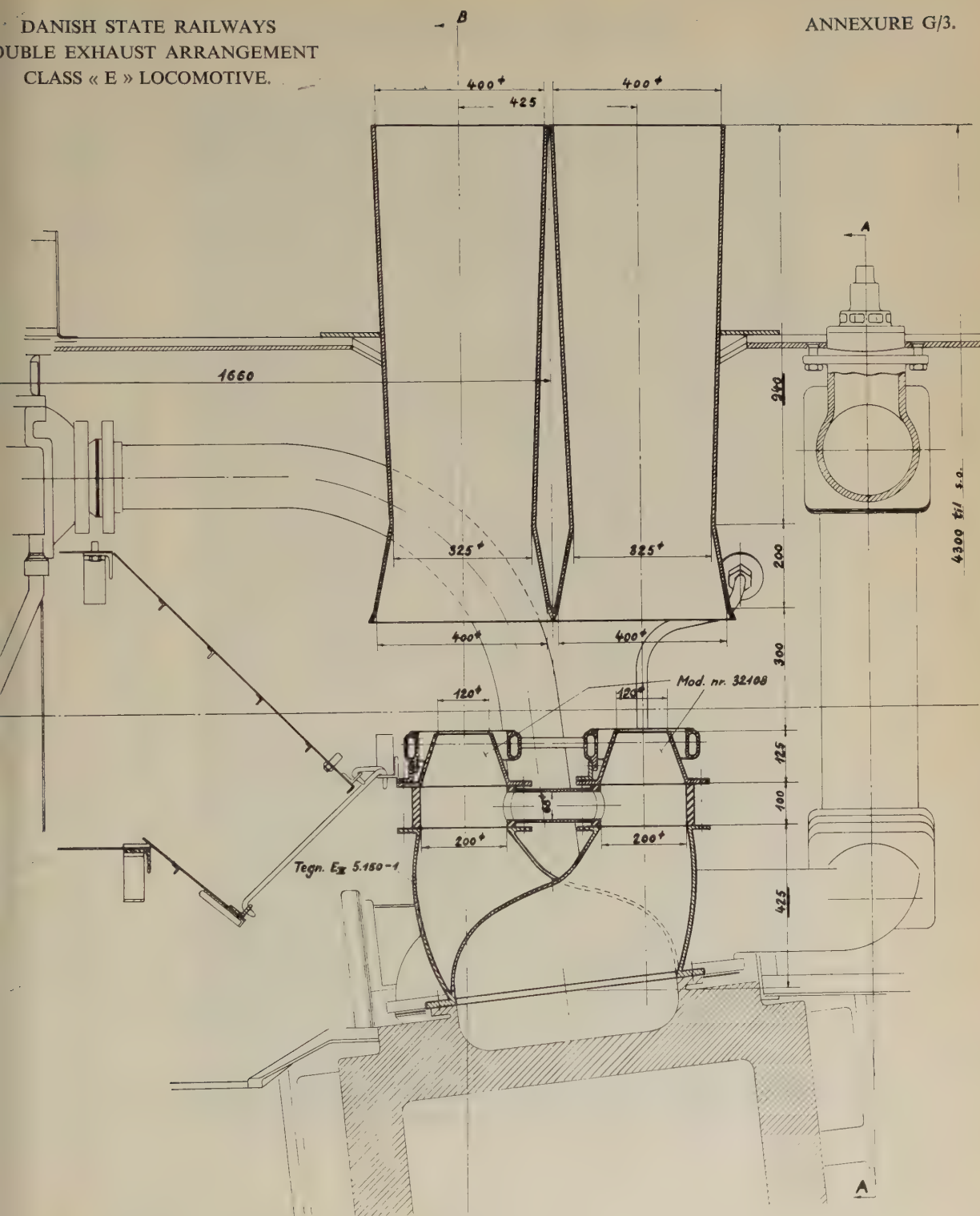






DANISH STATE RAILWAYS  
DOUBLE EXHAUST ARRANGEMENT  
CLASS « E » LOCOMOTIVE.

ANNEXURE G/3.

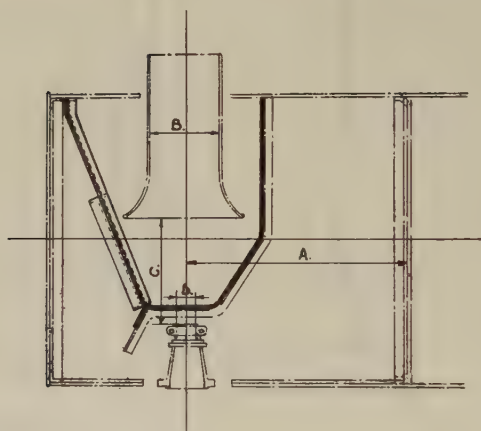




## ANNEXURE G/4.

## INDIAN RAILWAYS.

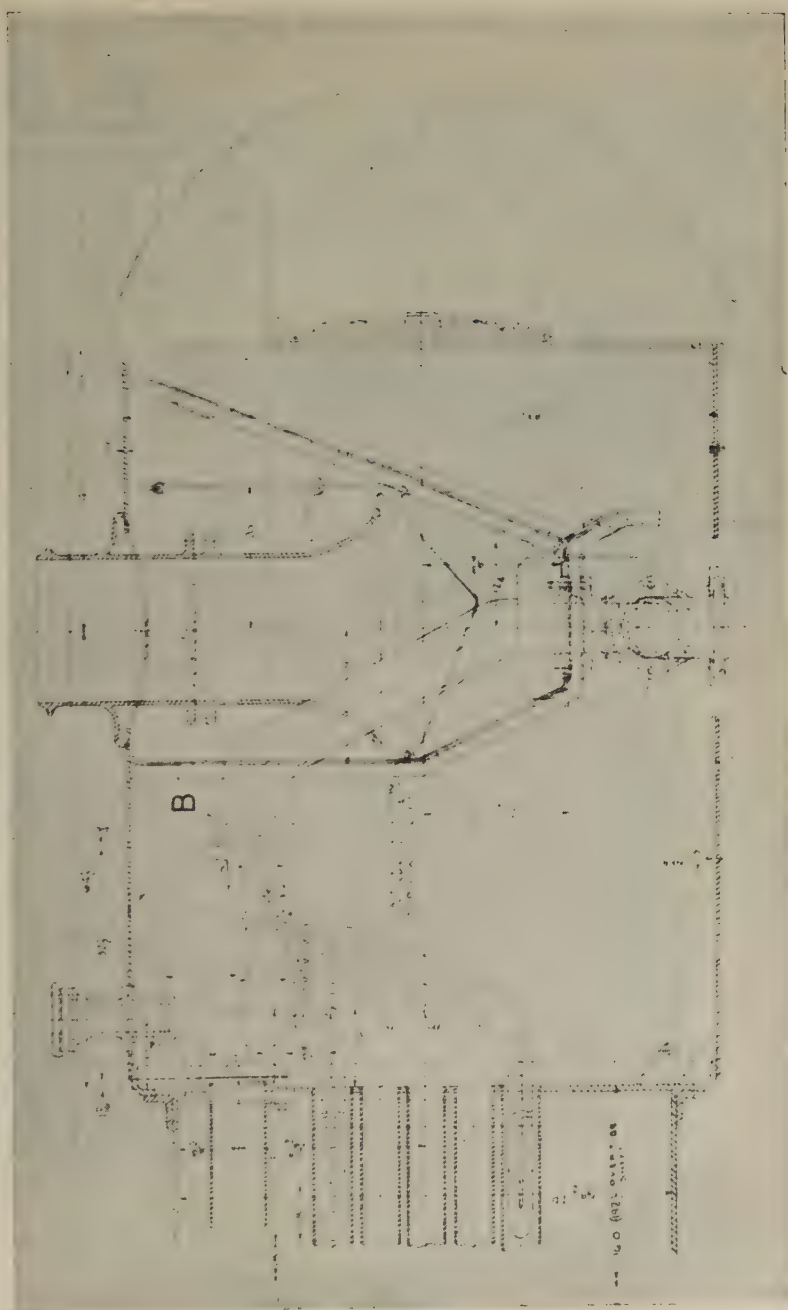
Smokebox. Self-cleaning type with spark arrestor.



Gauge	Class locos	A	B	C	D	Grate area
B.G.	WP	5'-4 1/2"	1'-8"	2'-7 5/8"	6"	46 sq. ft.
	WG	5'-4 1/2"	1'-8"	2'-7 5/8"	5 3/4"	46 sq. ft.
M.G.	YP	3'-10"	1'-6 3/4"	2'-2 3/4"	4 15/16"	28 sq. ft.
	YG	3'-5"	1'-6 3/4"	2'-2 3/4"	4 15/16"	28 sq. ft.

ANNEXURE, G/5.

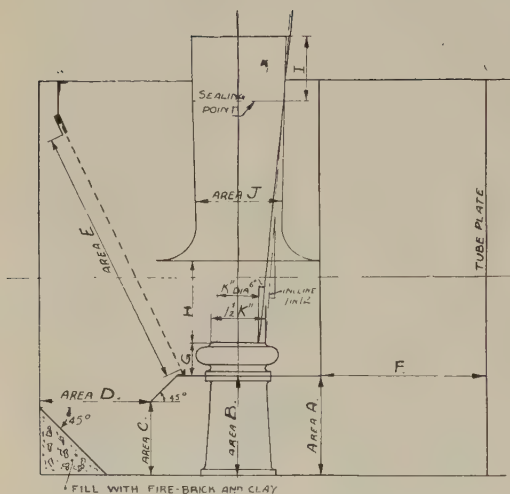
INDIAN RAILWAYS  
LONGITUDINAL SECTION OF SMOKEBOX CLASS « WP ».



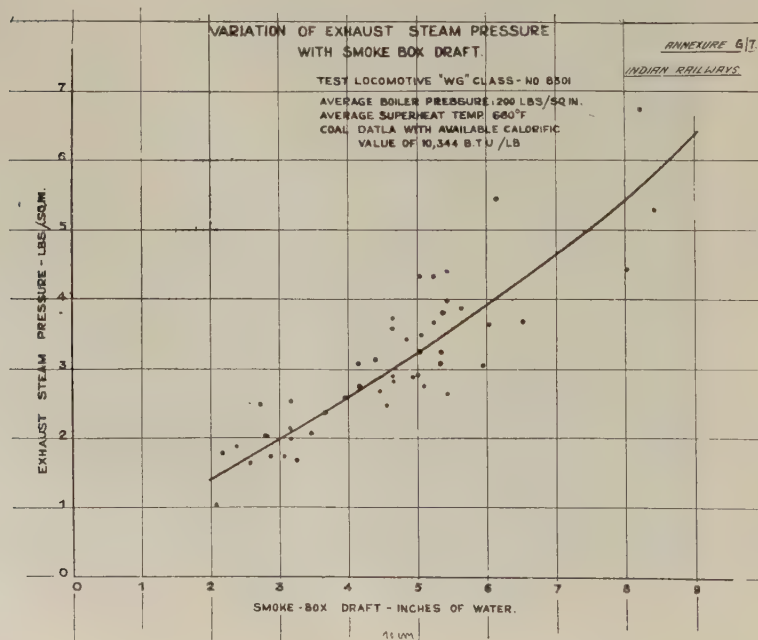
## APPENDIX, G/6.

## SOUTH AFRICAN RAILWAYS.

Recommended proportions for self  
cleaning smokebox.  
Based on minimum nett gas area through  
tubes & flues as 100 %.



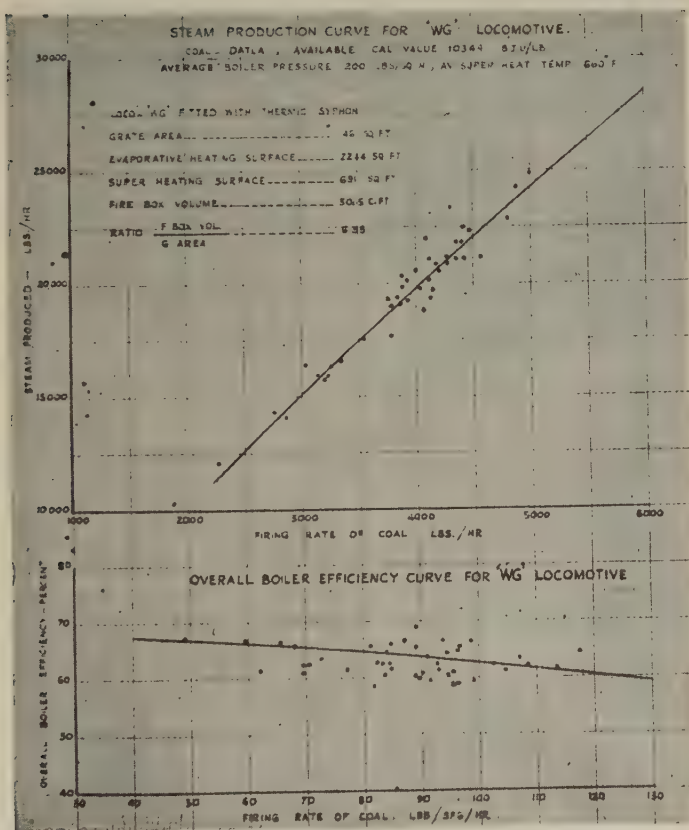
Area	Limits	Preferred
A	95 %—110 %	95 %
B	80 %—95 %	85 %
C	65 %—80 %	75 %
D	150 %—170 %	160 %
E	120 %—140 %	130 %
F		
J		
Dimension	Limits	Preferred
G	5"—6"	5"
H		
I		12"
K	To obtain satisfactory sealing	

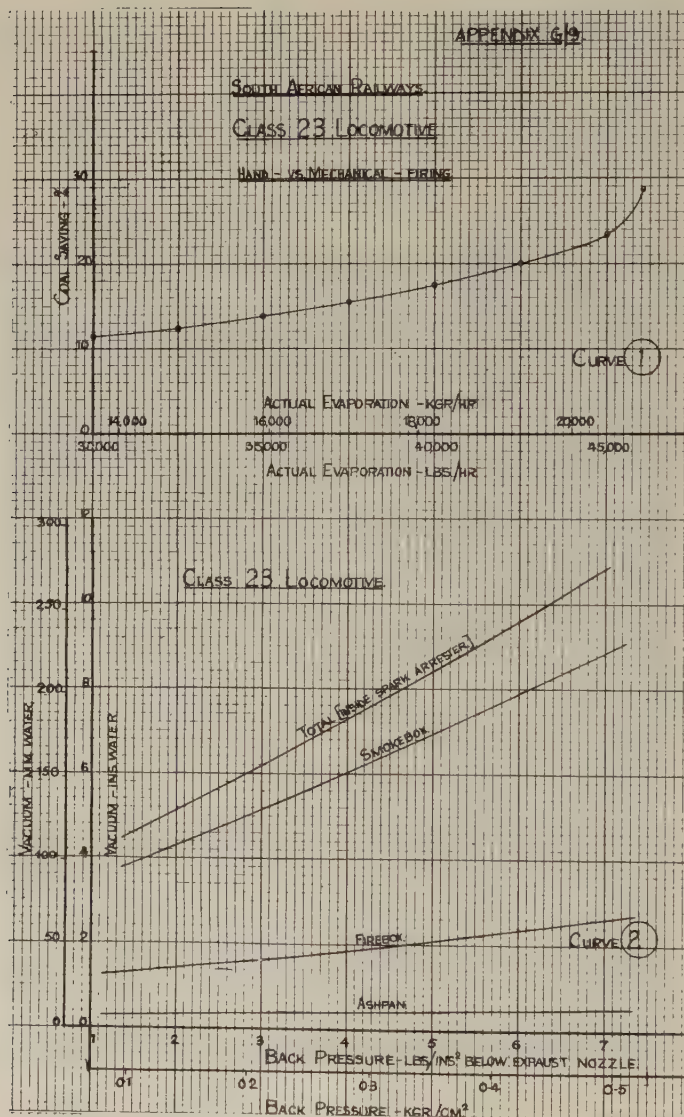


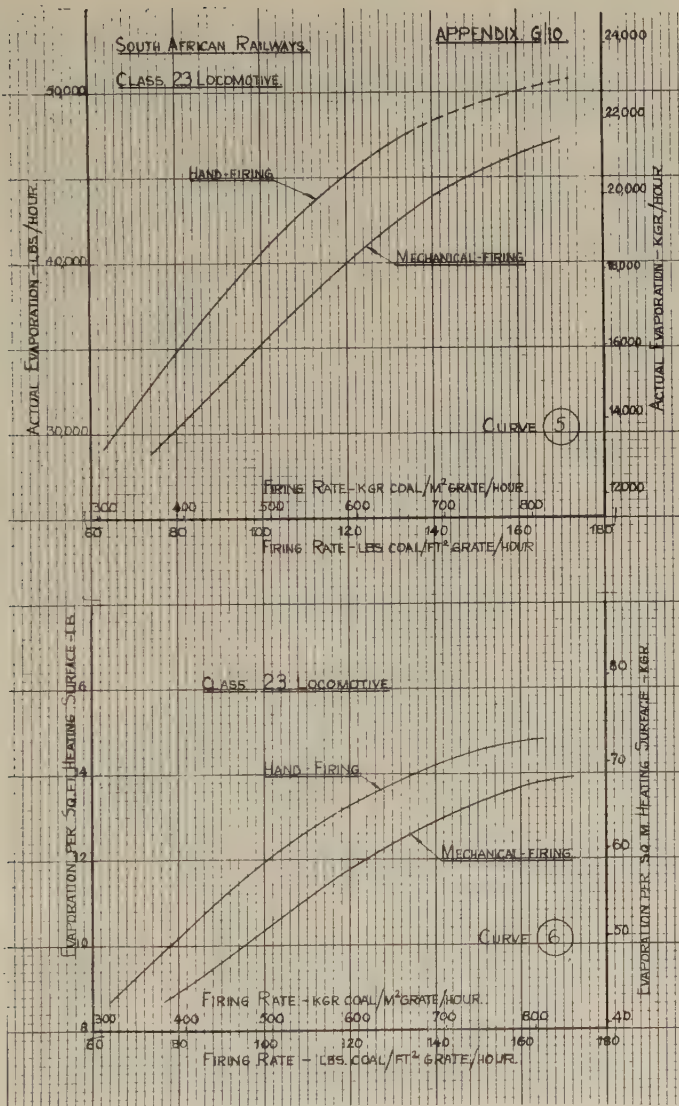


## ANNEXURE G/8.

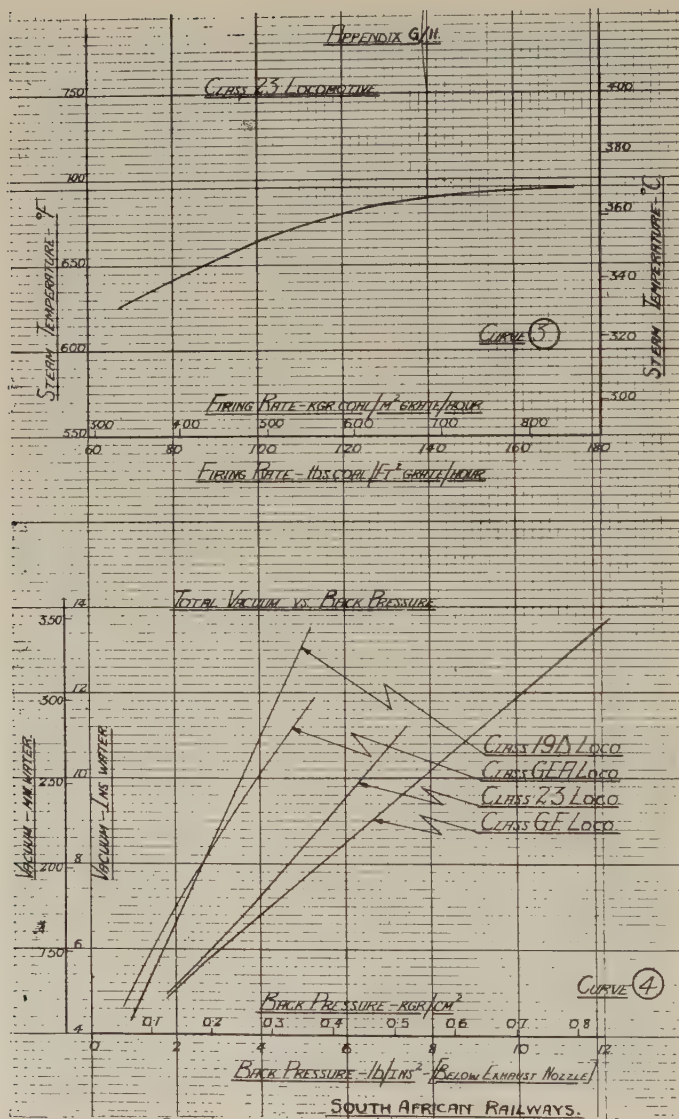
## INDIAN RAILWAYS.



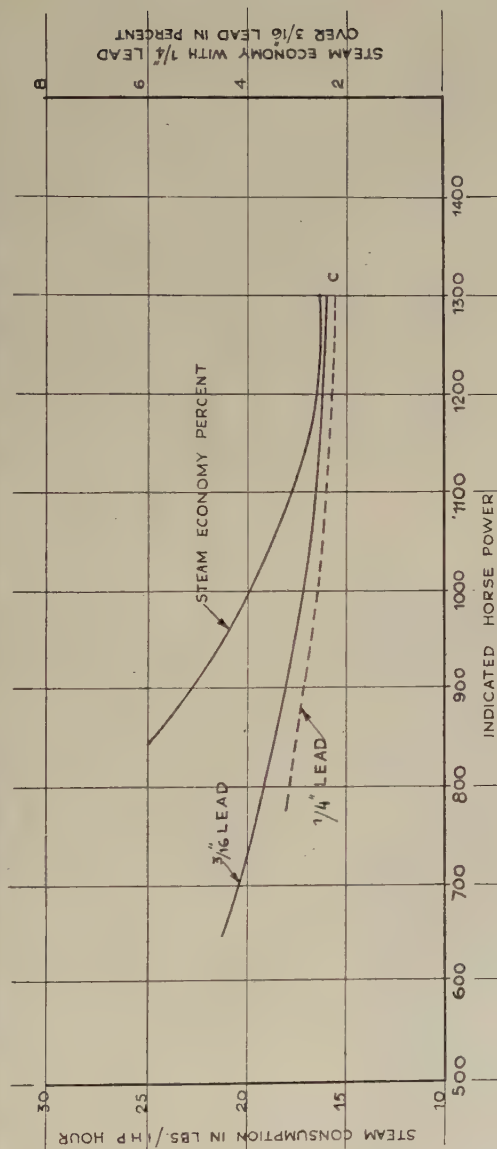








INDIAN RAILWAYS.  
Comparative steam consumption with 3/16" and 1/4" leads for « WP » locomotive at a speed of 40 m.p.h.  
Coal used-Datla, available calorific value-10 310 B.T.U./LB. Piston valve-12" dia. Steam lap-1 11/16" Exhaust - « line on line ».



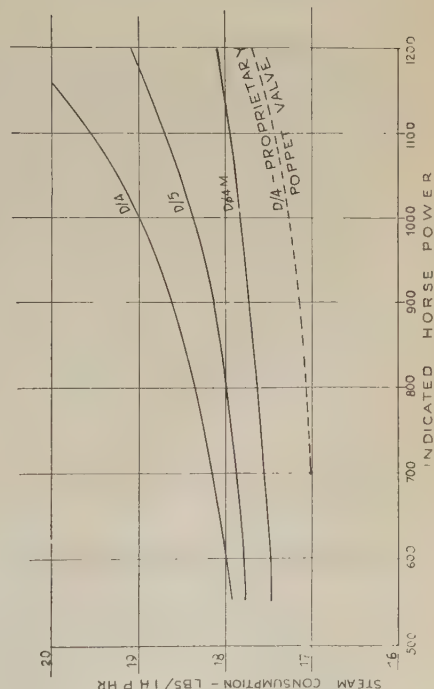
ANNEXURE H/2.

# INDIAN RAILWAYS.

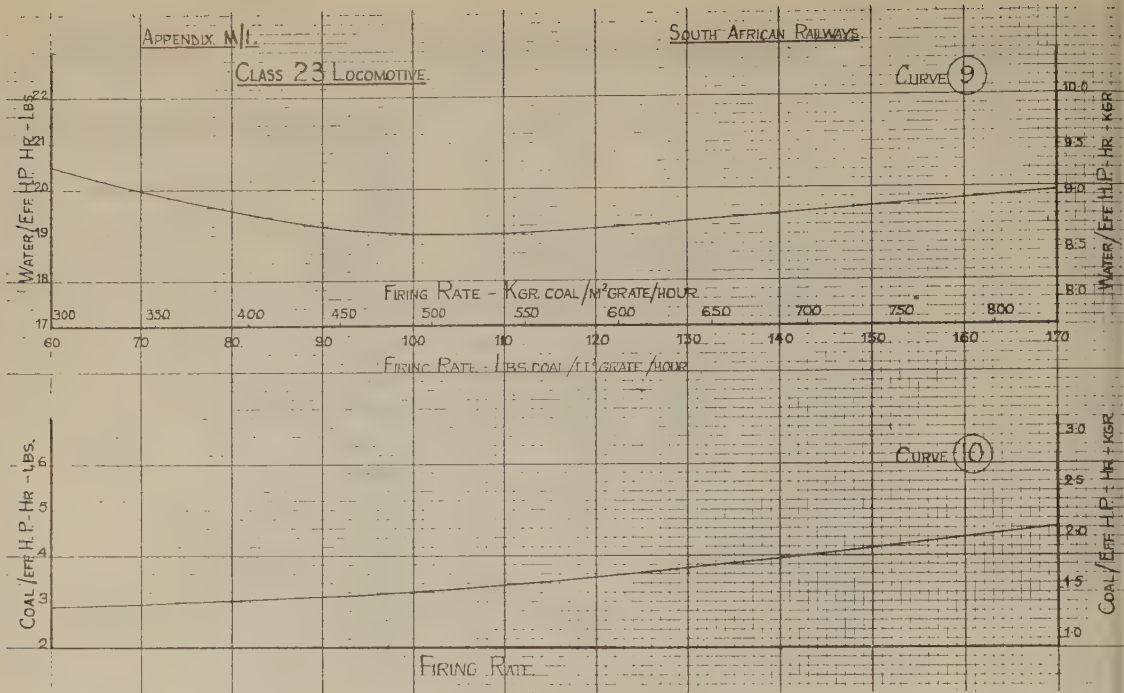
Comparative steam consumption with different valve gears.

Walschaerts.

----- Proprietary poppet valve.



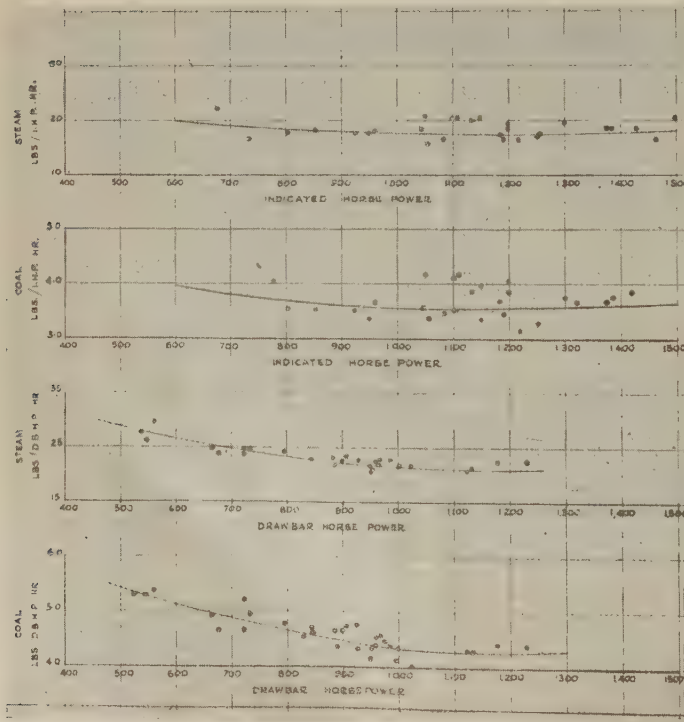
Class of loco.		D/4	D/5	D/4 M
Valve gear	Type	Walschaerts		
	Lead	1/8"	3/16"	3/16"
	Lap	1 1/4"	1 1/2"	1 7/8"
Piston valve dia.		10"		
Boiler pressure		180 lbs./sq.in.		
Cylinders	Number	Two		
	Diameter	20 1/2"		
	Stroke	26"		
Coupled-wheel dia.		6'-2"		
Speed		50 m.p.h.		



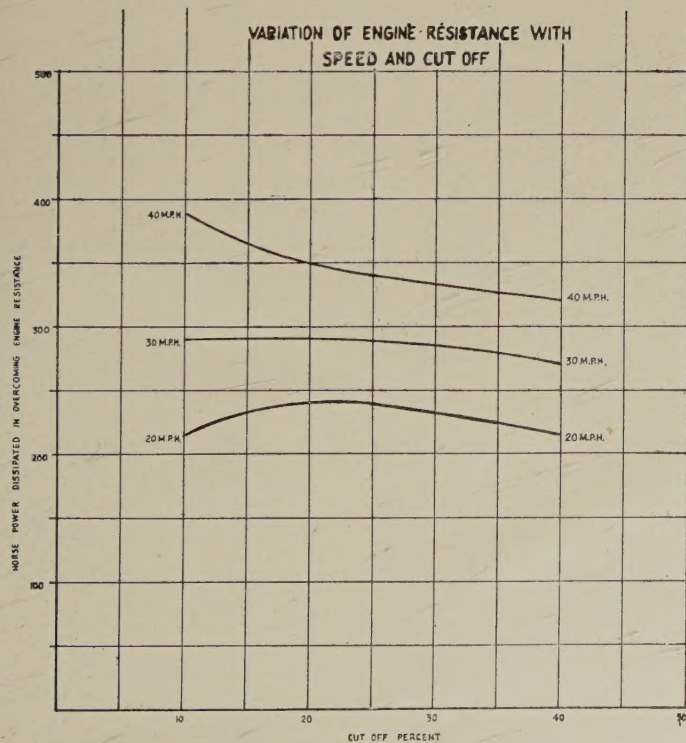
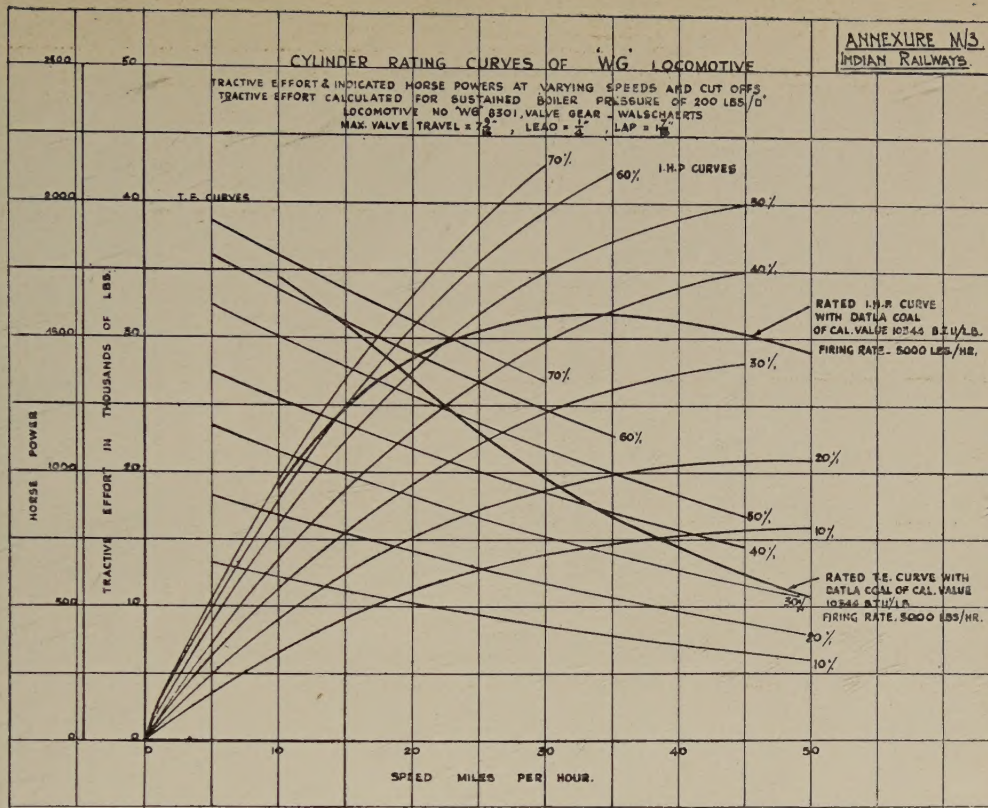
ANNEXURE M.I.

# INDIAN RAILWAYS.

Steam & coal consumption per I.H.P.HR. D.B.H.P.HR. for « WG » locomotive (speed range : 25-30 m.p.h.). Coal-Datla with available calorific value of 10 344 B.T.U./LL. Average boiler pressure of 200 lbs./sq.in. & superheat temp. of 660° F.







ANNEXURE M/4

INDIAN RAILWAYS









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